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FIRST REVISION

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GUNSIGHT MARK 31
MODS 1,2,3,4 AND 5
AND
AMPLIFIER MARK 121
MODS 1,2 AND 3

OVERHAUL

THIS PUBLICATION SUPERSEDES NAVWEPS OP 1940B DATED
1 DECEMBER 1958

PUBLISHED BY DIRECTION OF
THE CHIEF OF THE BUREAU OF NAVAL WEAPONS

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FOREWORD

Gun Sight Mk 31 Mods 1, 2, 4 and 5 and Amplifier Mk 121 Mods 1 and 2 are components of Gun Fire Control System Mk 70.

This publication is intended for use by qualified repair personnel in gun sight repair shops and is not intended for use aboard ship.

This publication consists of four chapters.

Chapter 1 - Introduction
Chapter 2 - Description
Chapter 3 - Overhaul and Repair
Chapter 4 - Test and Alignment Procedures

Personnel should be thoroughly familiar with chapters 1 and 2 before attempting repairs or adjustments. If repairs involve only the replacement of some specific component of the gun sight, refer to the appropriate instructions in chapter 3.

LIST OF EFFECTIVE PAGES

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SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These precautions are recommended safety precautions that personnel must understand and apply during many of the phases of maintenance.

EXERCISE EXTREME CAUTION WHEN WORKING IN LETHAL VOLTAGE AREAS.

Operating personnel must be alert at all times when working in areas where high potentials are present. Avoid, whenever possible, working with live circuits. Note also, that under certain circumstances, dangerous potentials may still exist after all power has been shut off. To avoid injury as a result of such potentials, make certain that all components capable of storing lethal potentials are discharged before touching them.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any one person service or adjust equipment alone without the presence or assistance of another person capable of rendering aid.

RESUSCITATION

Personnel working with or in areas where high potentials exist should be familiar with the methods of artificial respiration. Such information can be obtained from the Bureau of Medicine and Surgery.

The following major CAUTIONS are repeated from the text because if not strictly observed the effectiveness of the equipment or ship may be destroyed.

CAUTIONS

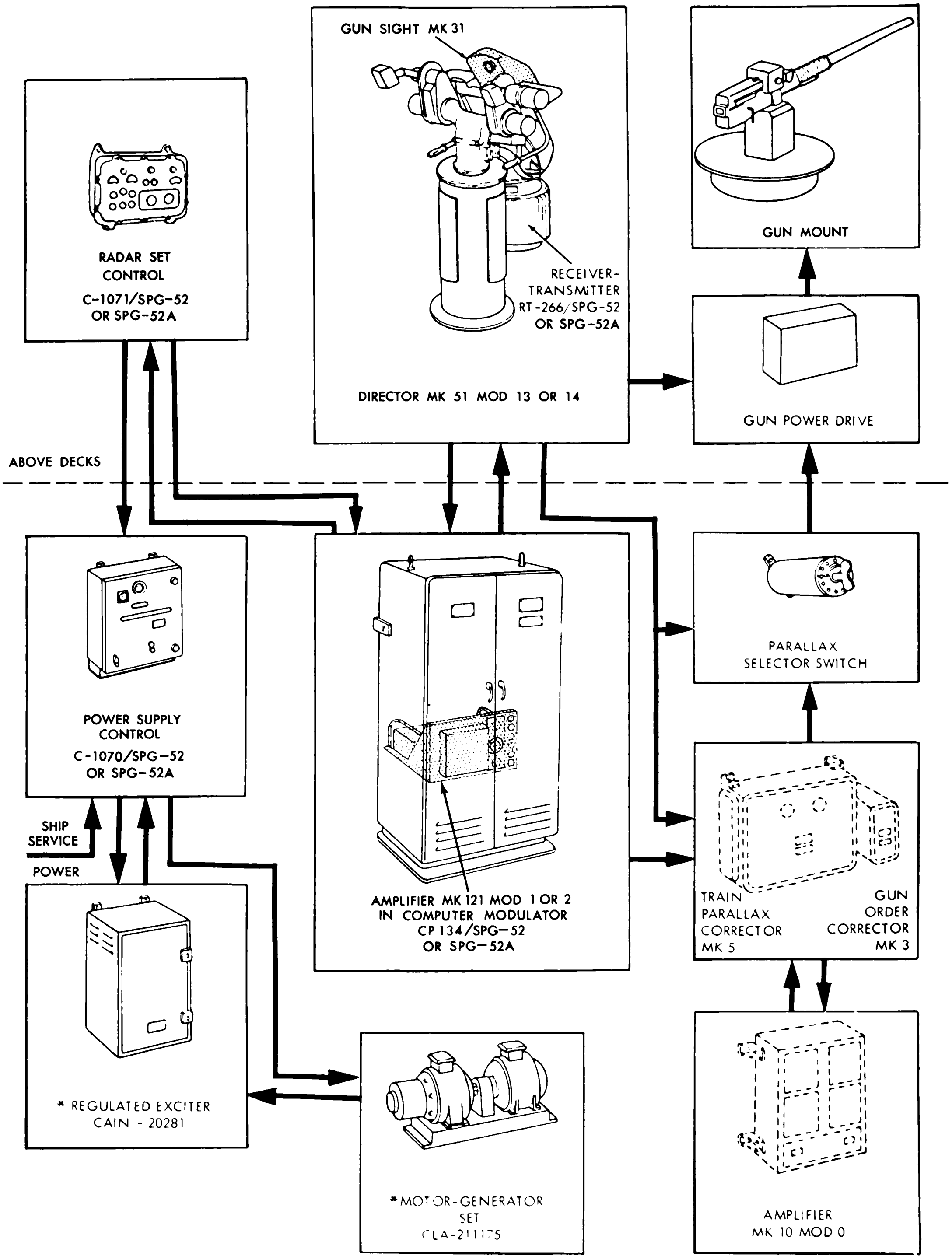
The gyroscope should not be run with the rear cover and gyro caging device removed unless the gyro retaining ring (SA2312203) is attached to the gun sight case. (Page 3-3)

Use extreme care in handling the unit with the brackets free to prevent the bearings and spiral connectors from becoming damaged. (Page 3-10)

To avoid damage, remove the rear cover and the caging device and eyepiece from the rear cover prior to the slotting operation. (Page 4-21)

Do not uncage the gyro with the nutation damper removed. (Page 4-24)

Avoid accidentally shorting the supply output. (Page 4-27)


GUN SIGHT MK 31
RECEIVER-TRANSMITTER RT-266/SPG-52 OR SPG-52A
DIRECTOR MK 51 MOD 13 OR 14
GUN MOUNT
GUN POWER DRIVE
RADAR SET CONTROL C-1071/SPG-52 OR SPG-52A
ABOVE DECKS
POWER SUPPLY CONTROL C-1070/SPG-52 OR SPG-52A
AMPLIFIER MK 121 MOD 1 OR 2 IN COMPUTER MODULATOR CP 134/SPG-52 OR SPG-52A
PARALLAX SELECTOR SWITCH
TRAIN PARALLAX CORRECTOR MK 5
GUN ORDER CORRECTOR MK 3
SHIP SERVICE POWER
* REGULATED EXCITER CAIN - 20281
* MOTOR-GENERATOR SET CLA-211175
AMPLIFIER MK 10 MOD 0

* NOT USED WHEN 3 PHASE 400 CYCLE 115 VOLT PRIMARY POWER IS AVAILABLE

Figure 1-1. Relationship of Elements of Gun Fire Control System Mk 70

Chapter 1

INTRODUCTION

Gun Sight Mk 31 is a gyroscopic lead computing sight using an electrically driven gyroscope as its principal element. It is designed for use as part of Gun Fire Control System Mk 70. Its function is to compute lead angle and superelevation. Figure 1-1 shows the relationship of the various elements of Fire Control System Mk 70.

Amplifier Mk 121 is a modular assembly of a range servo, range and range rate amplifiers, power and current supplies and a control unit. The amplifier assembly, figure 1-6, receives range and range rate information from Radar Set AN/SPG-52 or AN/SPG-52A. This information controls servo motors that drive potentiometers which furnish information to Parallax Corrector Mk 5 and Fuze Computer Mk 112 for computation of parallax and fuze time. Other servo driven potentiometers control the amount of lead angle.

Parallax Corrector Mk 5, figure 1-1, supplies parallax correction signals which are combined with director train signals to produce gun train orders. This results in the director line of sight and the gun line of fire converging at the future target position.

This system is designed primarily for use against aerial targets, but may be used against surface or fixed targets. Refer to NAVWEPS OP 1940A for a discussion of how Gun Fire Control System Mk 70 functions during antiaircraft (AA) and surface fire.

DIFFERENCES IN MODS

In the original manufacture of early mods of the gun sight and amplifier, Mods 1, 2 and 3, differences existed only in the ballistic correction. These differences compensated for the various applications of the gun sight with the Mod 1 being used in 3-inch 50 caliber gun installations, the Mod 2 used in 5-inch 38 caliber gun installations and the Mod 3 designed for use in 40-mm gun installations.

Subsequent to original manufacture, gun sight Mods 1 and 2 have been equipped with an improved gyro caging device by NAVWEPS ORDALT 4330. This ordalt was not performed on Mod 3 of the gun sight because of its limited use and manufacture.

Ballistic correction in the various mods of the gunsight and amplifier adjusts the units to the ballistic characteristics of the particular gun installation and results in the following differences between mods.

The weight of the superelevation computer weight.

Values of the resistors in the resistor pack of initial velocity switch.
The value of the computing potentiometer (P2) of the range rate to servo unit.
The taps used on the range magnet.

Later mods of the gun sight, mods 4 and 5, are products of improved design and closer manufacturing tolerances and provide the following improvements over earlier mods.

Improved optics
Better reticle and track signal illumination
Positive rack and pinion focusing
Elimination of mirror vibration
Electrical caging and uncaging of the gyro

The mod 4 has ballistic correction for use in 3-inch 50 caliber gun installations and the mod 5 has ballistic correction for use in 5-inch 38 caliber gun installations.

Various mods of the gun sight are shown in figures 1-2, 1-3, 1-4 and 1-5. Table 1 gives a comparison between all mods of the gun sight after NAVWEPS ORDALT 4330 has been performed on Mods 1 and 2.

THEORY OF OPERATION

A moving target travels a considerable distance during the time that a projectile fired from a gun is on its way from gun to target. Therefore, it is necessary to aim the gun at the point where a projectile fired from the gun can hit the target. This position is known as the advance position of the target.

The function of the gun sight is to offset the line of the sight (LOS) from the axis of the gun bore enough so that the gun is always aimed at the advance position of the target while the line of sight is on the target.

This offset is called the lead angle and is affected by range, range rate, elevation and the angular velocity of the LOS in tracking the target. An additional offset is needed to compensate for the effect of gravity on the projectile after it leaves the gun. This is called superelevation and is composed of the same three factors that affect lead angle.

Gun Sight Mk 31 computes lead angle and superelevation by the same general principles as other gyroscopic lead computing sights, but with three main differences: in normal operation, the range and range rate components of lead angle and superelevation are automatically controlled by range and range rate information from the fire control radar; director sight angle and sight deflection information are used to keep the fire control radar antenna pointed along the line of sight; and a built-in memory circuit provides continuous Time of Flight Solution tracking for approximately four seconds if the radar momentarily loses the target.

Although the gun sight is located topside and the amplifier below decks, they are mutually dependent and are described as one unit.

The sight is secured to the director so that it follows the

Table 1-1. Differences Between Mods of Gun Sight MK31

Mods 1 and 2	Mods 1 and 3	Mods 1 and 4	Mods 1 and 5	Mods 2 and 3
Ballistic Correction, (Mod 1-3"50, Mod 2-5"38.)	Caging device, Auto in Mod 1 Manual in Mod 3; Ballistic Correction, (Mod 1-3"50, Mod 3-40mm). Vibration reduced in Mod 1.	Improved optics, vibration eliminated, better illumination and positive focusing in Mod 4.	Improved optics, vibration eliminated, better illumination and positive focusing in Mod 5; Ballistic correction (Mod 4-3"50, Mod 5-5"38).	Caging device auto in Mod 2 Manual in Mod 3; Ballistic correction (Mod 2-5"38, Mod 3-40mm) Vibration reduced in Mod 2
Mods 2 and 4	Mods 2 and 5	Mods 3 and 4	Mods 3 and 5	Mods 4 and 5
Improved optics, vibration eliminated, better illumination and positive focusing in Mod 4; Ballistic correction, (Mod 2-5"38, Mod 4-3"50).	Improved optics, vibration eliminated, better illumination and positive focusing in Mod 5.	Improved optics, vibration eliminated, better illumination and positive focusing in Mod 4; Caging device auto in Mod 4 manual in Mod 3; Ballistic correction (Mod 3-40mm, Mod 4-3"50).	Improved optics, vibration eliminated, better illumination and positive focusing in Mod 5; Caging device auto in Mod 5 manual in Mod 3; Ballistic correction (Mod 3-40mm, Mod 5-5"38).	Ballistic Correction, (Mod 4-3"50, Mod 5-5"38).

movements of the director. For descriptive purposes the director axis is defined as a line that is parallel to the bore of the controlled gun without parallax correction.

The gun sight has two principal units, both located within the sight case. They are the telescope and the gyro unit.

The director operator sees the target through an optical system consisting of the telescope fixed to the sight case and a mirror which is part of the gyro unit.

The gyro unit consists of an electrically driven gyroscope mounted on gimbals pivoted inside the sight case. When the gyro is running but the sight case is not moving, no lead angles are composed. When the sight case is moved, the gyro tries to remain in its original position, but is forced to follow the motion of the sight case as explained in the following paragraphs.

An eddy current disk attached to the rotor of the gyroscope spins in the field of the range magnet. When the gyro spin axis is centered with respect to the magnet, the eddy current disk and the field of the range magnet are in balance. When the sight case moves, the magnet also moves and forces the gyro to follow it. This is done by the force of the range magnet acting on the eddy current disk in such a way that the gyro precesses toward the range magnet until balance is reached.

Precession is the characteristic movement of the gyro at right angles to a force acting on it. If the gyro is spinning in a clockwise direction, figure 1-7, the precession of the gyro is 90 degrees clockwise from the force. If the gyro were spinning counterclockwise, the precession of the gyro would be 90 degrees counterclockwise from the force. Thus, if the director is moving, the gyro is following in an attempt to regain a balanced position. As long as the director is moving, the gyro will follow, but will lag behind.

In order that gyro lag may increase as range increases, the current flowing in the range magnet must decrease. To do this, a range signal from the fire control radar is amplified by Amplifier Mk 121 and sent to a servomotor which in turn positions a range computing potentiometer. The range computing potentiometer in the range servo unit varies the current in the range magnet; that is, decreases the current for longer range and increases it for a shorter range. The amount of gyro lag also is affected by range rate. More lag is required for high opening range rates than for high closing range rates. To control the lag, the range rate computing potentiometer in the range rate servo unit changes the current in the range magnet for a changing range rate. The range rate servo unit works in the same way as the range servo unit. Both will be described in more detail in the next chapter.

The gun sight also computes superelevation. More super-

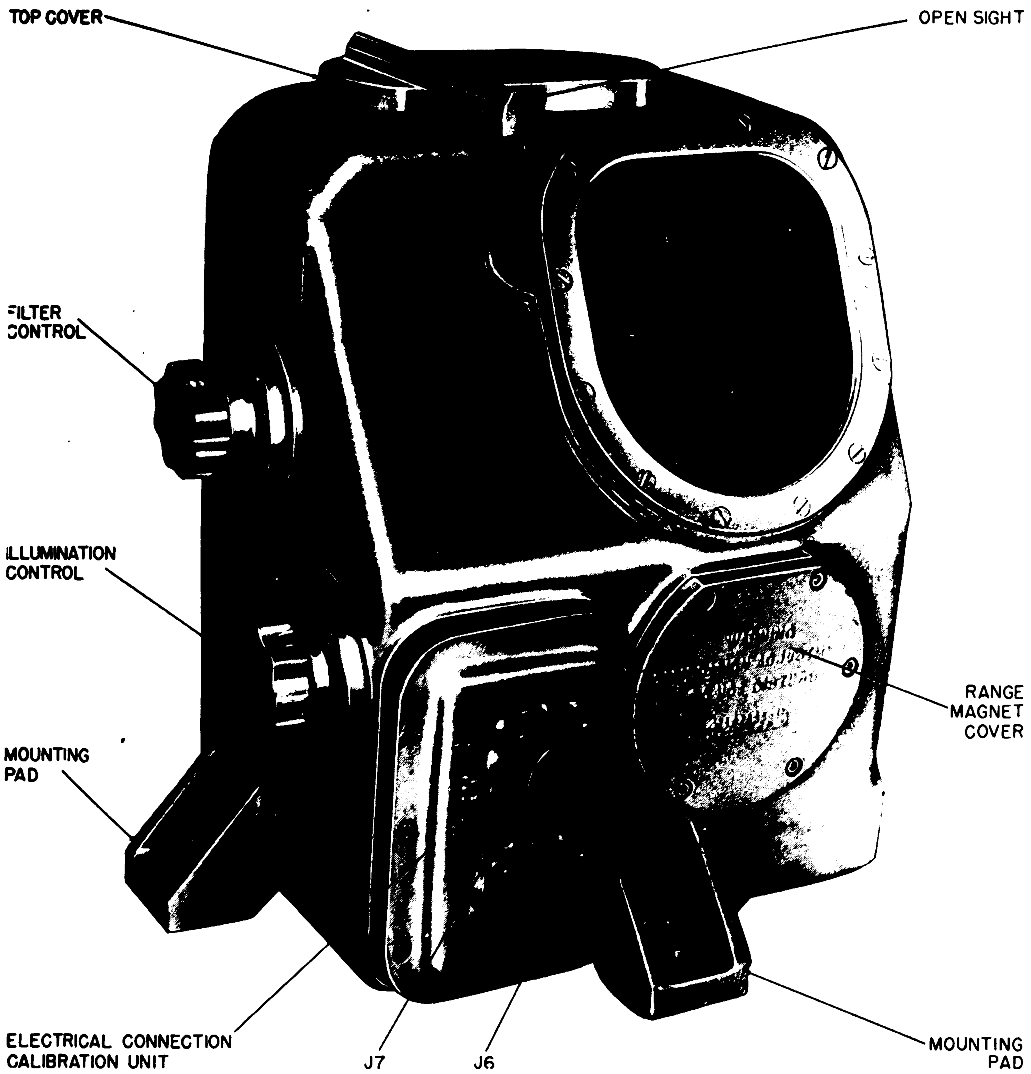


Figure 1-2. Gun Sight Mk 31, Front View

elevation is required for low elevation, high opening range rate, long range targets than for high elevation, high closing range rate, short range targets. The superelevation computer is a weight which acts on the upper gimbal pivot causing it to turn. The turning motion causes the gyroscope to precess downward which, in turn, causes the line of sight to drop. Since the director operator keeps the line of sight on the target, both the director axis and the gun are elevated. The effect of the superelevation weight is greatest when the director axis is horizontal and decreases as it is elevated. The range rate servomotor is mechanically linked to the superelevation weight so that it has more effect at high positive range rates than at high negative range rates. The pull of the range magnet controls the lag resulting from range rate and elevation compensation as described previously.

Because of the construction

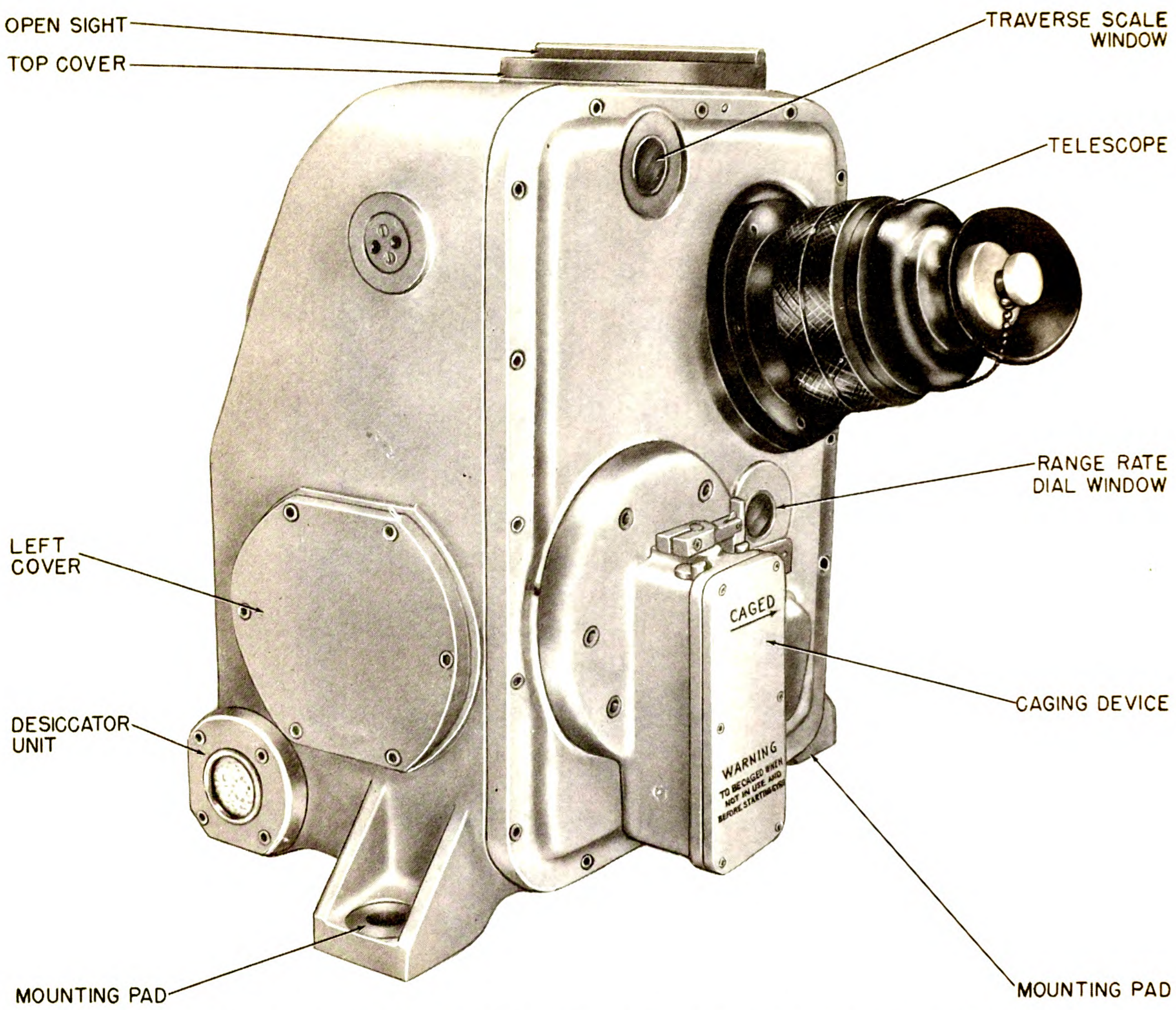


Figure 1-3. Gun Sight Mk 31 Mods 1 and 2, with Electrical Caging Device, Rear View.

of the optical system, turning the mirror to the right or left produces a false upward movement of the reticle image and depresses the line of sight. To correct for this movement, the gyro must be made to precess upward. A compensating magnet connected in series with the range magnet pulls on the gimbal frame. The motion of the gimbal frame exerts a precessing force on the gyro causing it to move upward. The mirror follows the motion of the gyro and lowers the reticle image. When the precessing force of the gyro balances the force of the range magnet, motion stops and the proper correction has been introduced.

DATA

The following data applies to all mods to Gun Sight Mk 31 and Amplifier Mk 121.

POWER SUPPLY. The equipment requires 115-volt, 60-cycle single-phase AC power and 115-volt 400-cycle three-phase AC power. The

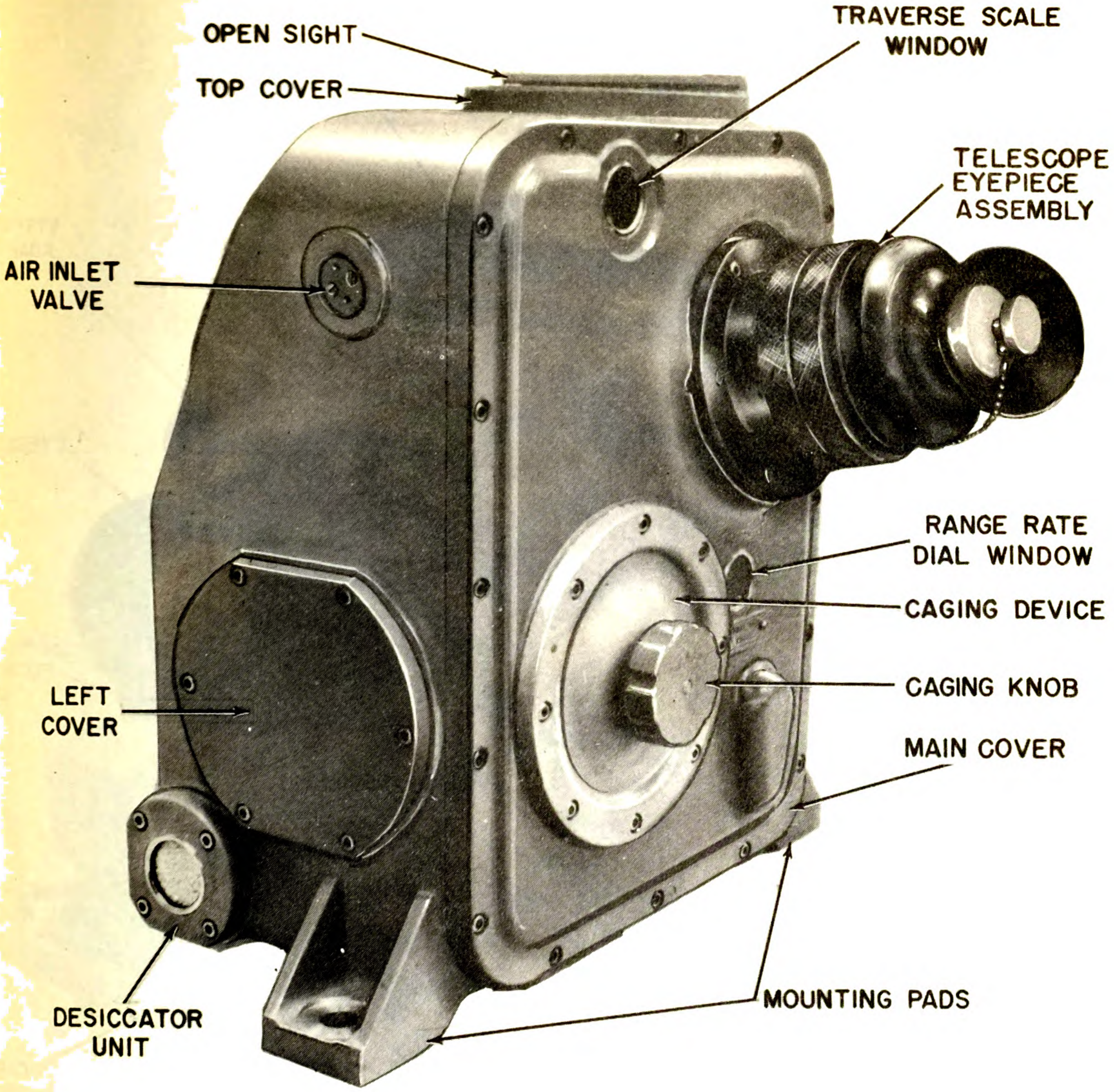


Figure 1-4. Gun Sight Mk 31 Mods 1 and 2, without Electrical Caging Device, Rear View.

maximum requirements are:

400 cycle .... Starting peak - 6 amperes
Running - 3 amperes
60 cycle ... Peak and continuous - 1.5 amperes

WEIGHT and DIMENSIONS

Unit	Height	Width	Depth	Weight
Gun Sight	16 5/16 in.	15 1/8 in.	14 3/4 in.	79 lbs
Amplifier	11 3/4 in.	19 in.	16 1/8 in.	65 lbs

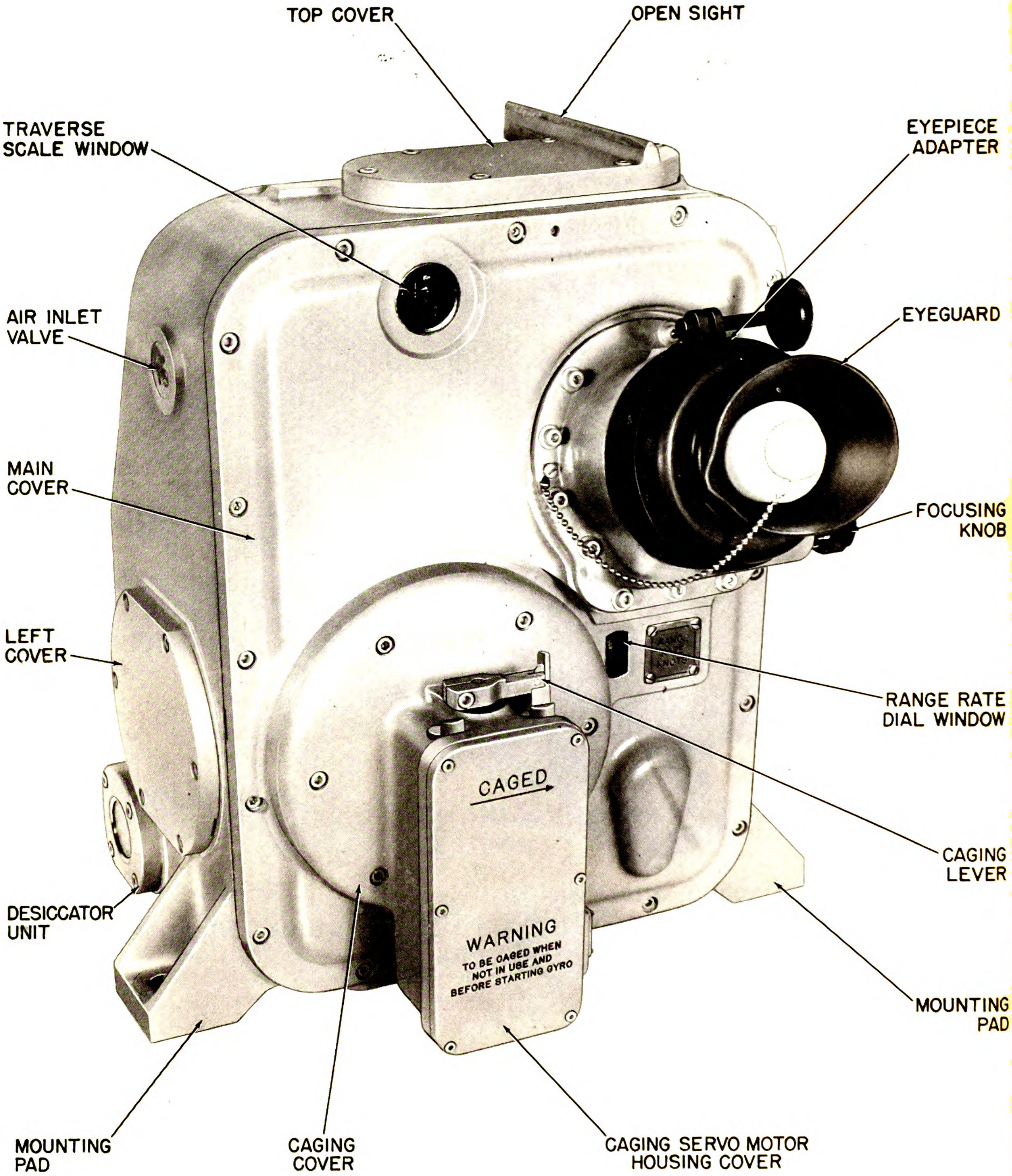


Figure 1-5. Gun Sight Mk 31 Mods 4 and 5, Rear View

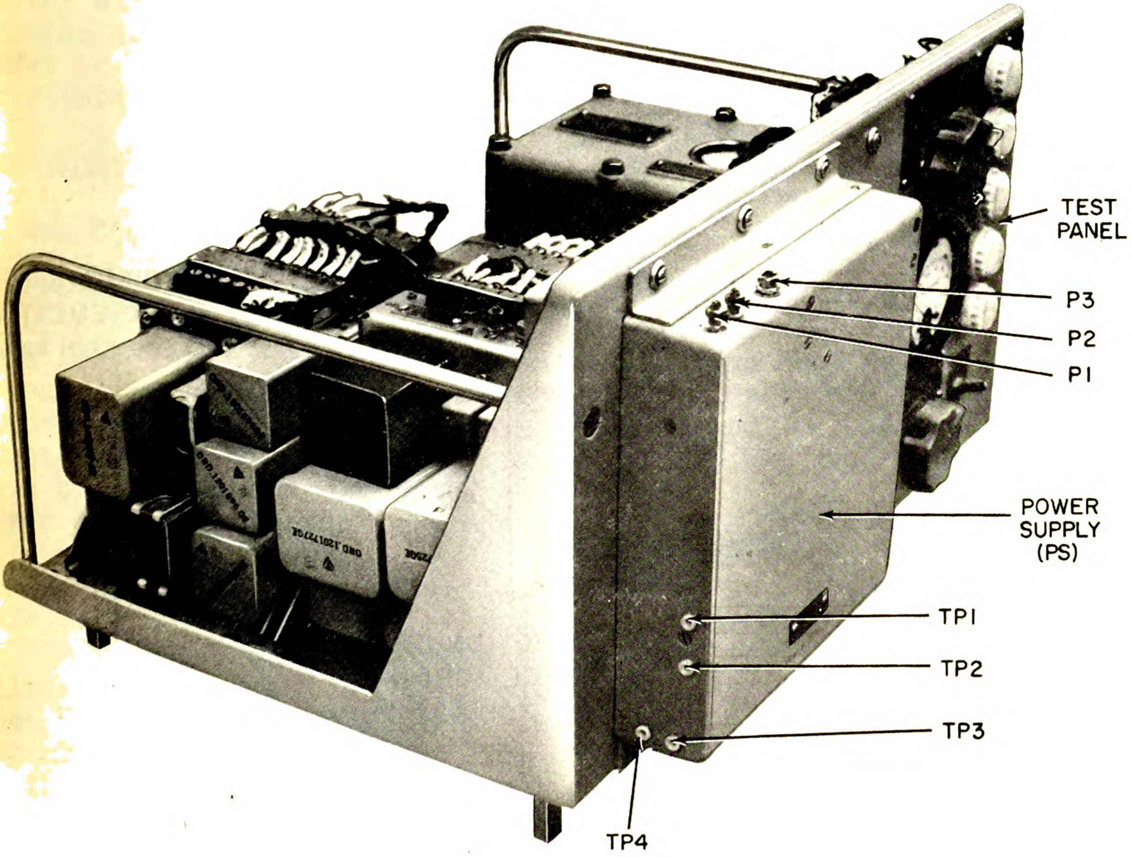


Figure 1-6. Amplifier Mk 121, Left Front View

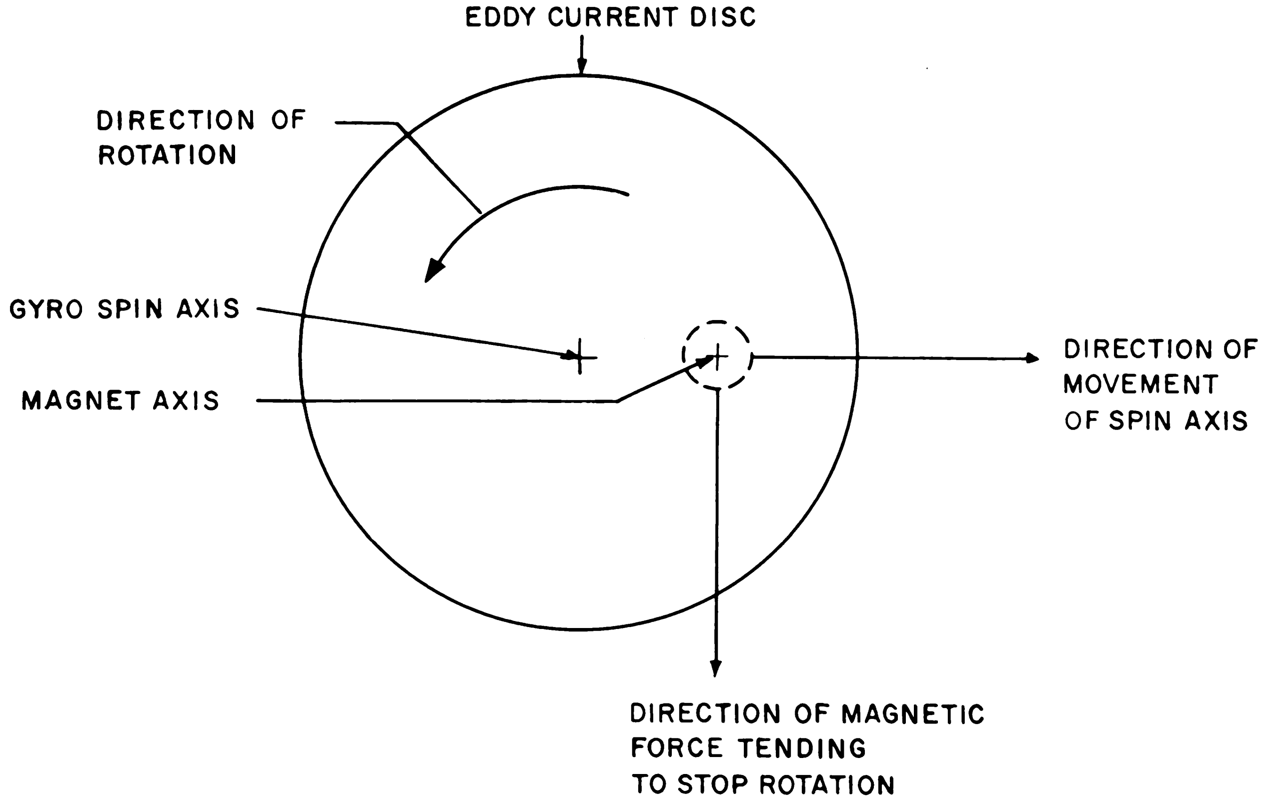

EDDY CURRENT DISC
DIRECTION OF ROTATION
GYRO SPIN AXIS
MAGNET AXIS
DIRECTION OF MOVEMENT OF SPIN AXIS
DIRECTION OF MAGNETIC FORCE TENDING TO STOP ROTATION

Figure 1-7. Precessing Effect of Force Applied to Gyro, Diagrammatic

Chapter 2

DESCRIPTION

This chapter describes the major components of Gun Sight Mk 31 and Amplifier Mk 121 in detail adequate to orient only the repairman. Personnel concerned with operation and maintenance of this equipment should refer to NAVWEPS OP 1940A for a more detailed description

GUN SIGHT MK 31

Gun Sight Mk 31, figures 2-1 and 2-2, basically consists of the gyroscope and linkage unit, telescope, range magnet, range rate servo unit, superelevation computer and compensating magnet mounted in the gun sight case. These components are made accessible by removal of the back cover of the gun sight case.

The outside of the gun sight case is fitted with the illumination control and telescope filter control on its right side when viewed from the rear of the assembled unit. The left side of the cage is fitted with an air inlet valve and a removable cover that provides access to the spiral connector of the sight angle pickoff. A sight window and bezel, an electrical connection and calibration unit, and the range magnet are mounted in openings in the front of the gun sight case. An access cover plate with an integral open sight is mounted over an opening in the top of the sight case to provide access to telescope illumination lamps and a removable plug. The plug provides access to the mirror adjustments on the gyroscope unit. An access cover on the bottom of the gunsight case provides access to the spiral connector of the sight deflection pickoff.

Mounting pads integral with the lower end of the case are used to secure the assembled gunsight to the gun director.

GYROSCOPE AND LINKAGE UNIT. The gyro and its associated linkage, figure 2-3, is located in the left side of the gun sight case. The components of the gyro unit are mounted in a gimbal frame. At the top and extending to the rear is the traverse scale, supported on a bracket with balancing stud. The sight mirror is just below the traverse scale. It is linked to the gyroscope and pivoted to move up or down with it. The link is spring loaded

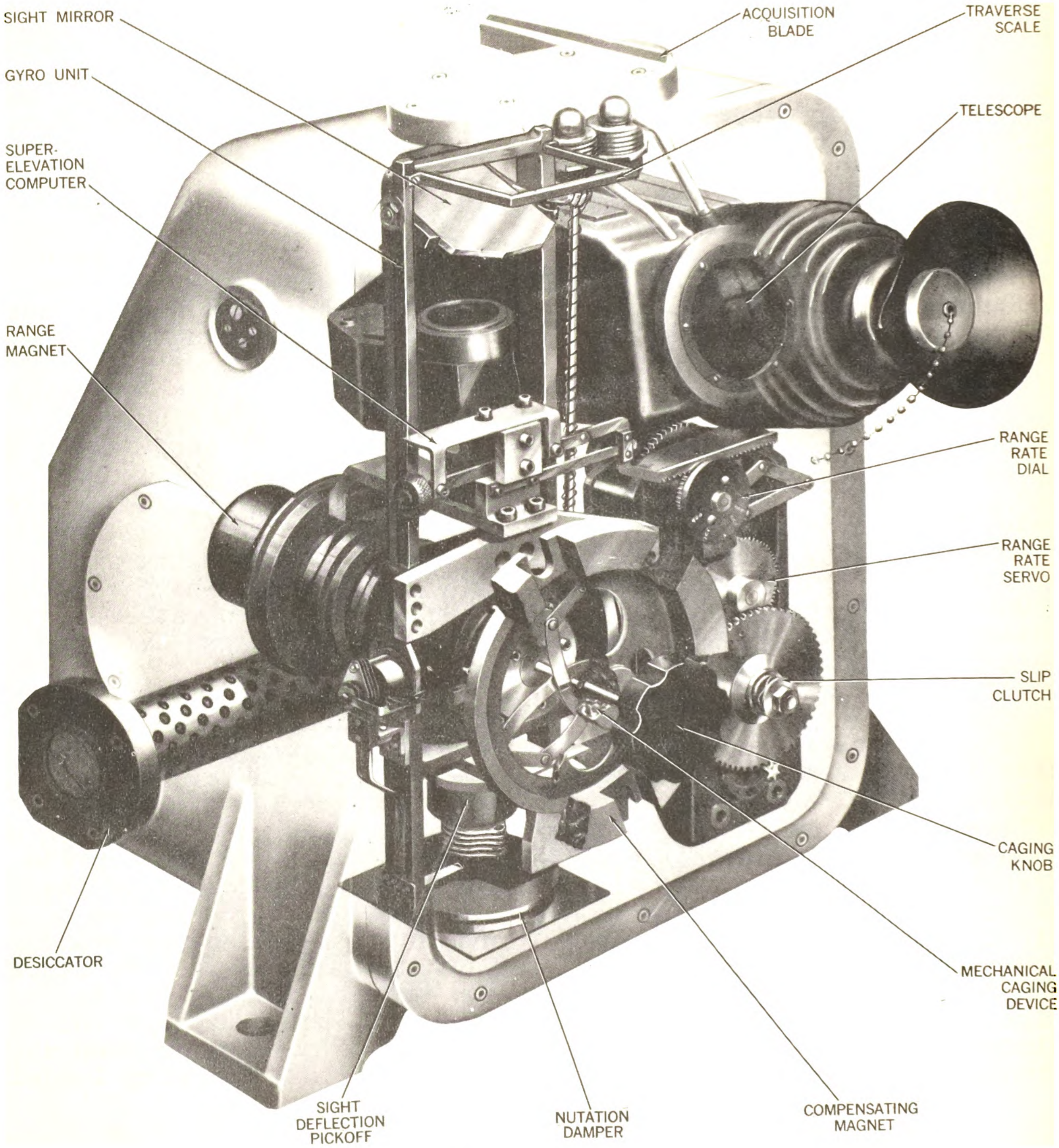


Figure 2-1. Gun Sight Mk 31 Mods 1, 2, and 3, Internal Arrangement, Before Ordalt 4330.

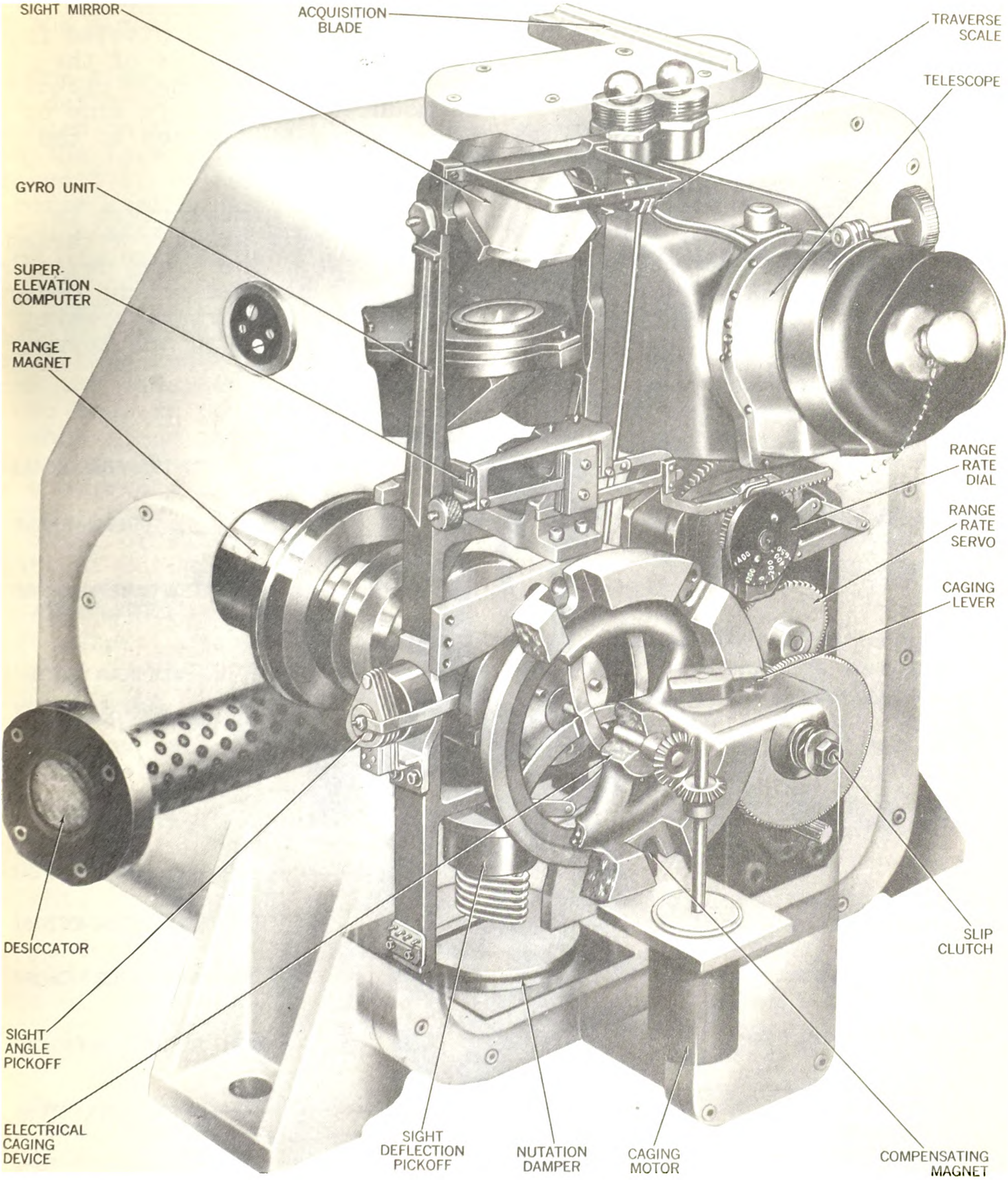


Figure 2-2. Gun Sight Mk 31 Mods 4 and 5, Internal Arrangement, Back Cover Removed

to reduce mirror vibration in Mods 1 and 2 only.

Below the sight mirror is the upper gimbal pivot. The pivot bearing is supported by a bracket secured to the case fore and aft. This bracket also holds the superelevation computer, figure 2-4. The computer is connected to the range rate servo by a rack and linkage and operates a pinion on the upper gimbal pivot by a face gear sector.

The gyroscope is mounted between the cross bars of the gimbal frame and is pivoted from bearings on each side of the frame. The sight angle pickoff is mounted on the left side of the frame and attached to the gyro pivot.

The lower gimbal pivot is supported by a bracket attached to the case. The sight deflection pickoff is mounted on the under side of the supporting bracket and is connected to the lower

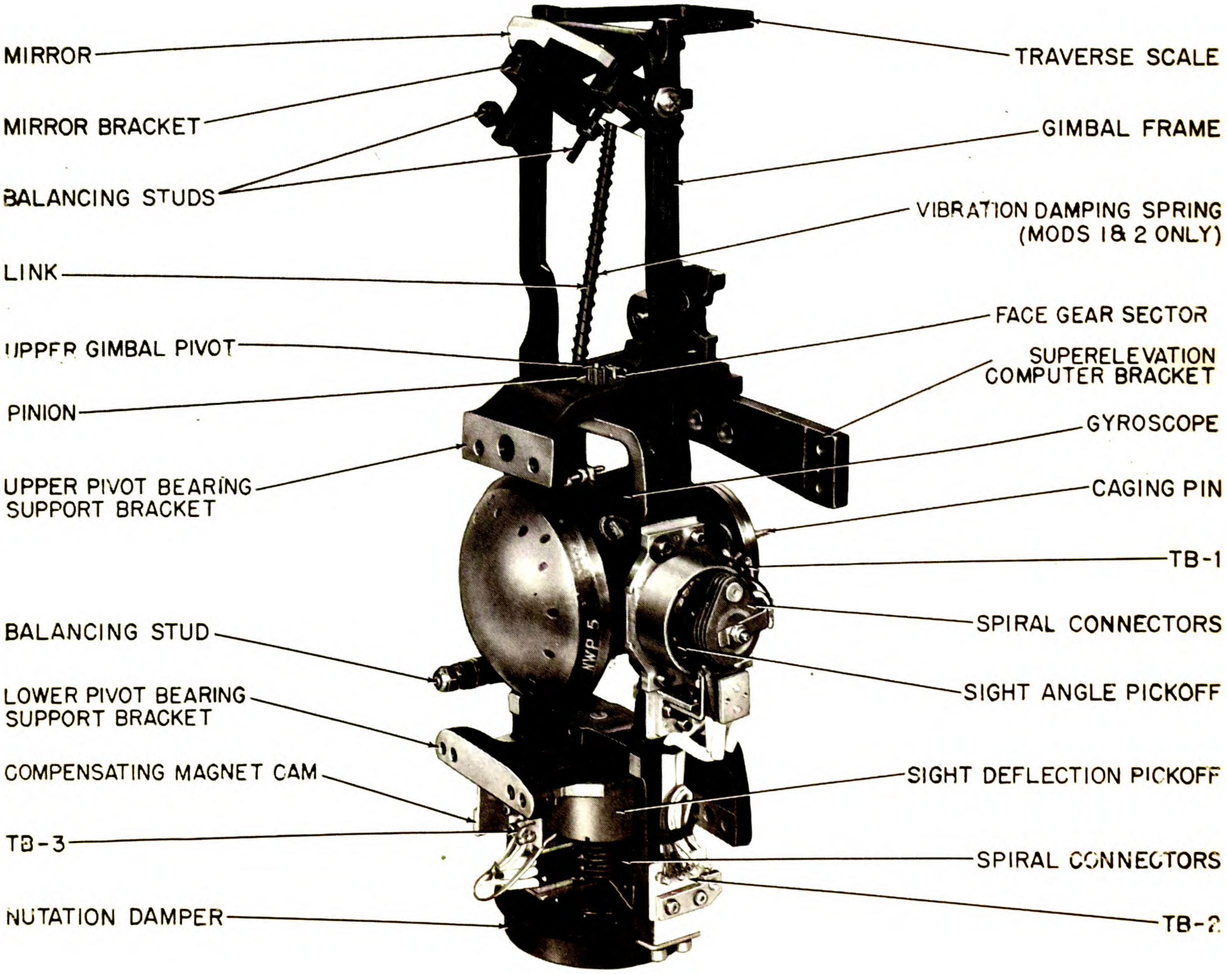


Figure 2-3. Gyroscope and Linkage Unit

gimbal pivot. A stop on the lower bracket limits the motion of the gimbal frame in traverse.

The sight angle pickoff and the deflection pickoff are mounted on the left gyro pivot and the lower gimbal pivot respectively. Each consists of a rotor excited at 115 volts and a stator. Movement of the gyro produces pickoff signals corresponding to sight angle and sight deflection. These signals are fed through spiral connectors and terminal boards into the radar antenna position servo loop to position the radar antenna along the optical line of sight. The nutation damper is the lowest unit on the gimbal frame. It dampens small circular or elliptical movements of the gyro. The damper unit consists of a base, an inertia wheel mounted on a pivot shaft attached to the base, a spring connecting the base and the inertia wheel, and a cover. The cover is soldered to the base and the damper filled with silicone fluid.

SUPERELEVATION COMPUTER. The superelevation computer, figure 2-4 is made up of a fixed weight, an adjusting weight and a rack and link mounted on a support bracket. The computer is made accessible for replacement of components or adjustment by removal of gun sight case back cover.

The superelevation weight is offered in poundage for gun sight mods having different ballistic correction. The weights are not interchangeable.

TELESCOPE, FILTER, AND ILLUMINATION UNITS. The six power telescope for the Gun Sight Mods 1, 2, and 3, figure 2-5, consists of a three-lens eyepiece group, a reticle, the filter unit, a mirror, an angle prism, an objective lens, and two small auxiliary prisms.

The telescope for Gun Sight Mk 31 Mods 4 and 5, figure 2-6, **basically differs from that used** in mods 1, 2 and 3 of the gun sight in that the later telescope has improved optics, positive rack and pinion focusing control and better illumination of the track signal. In the later mods a small mirror in track signal light well housing reflects light into a condenser lens over the track signal light pilot hole where it is collimated and sent into a tiny prism cemented on the reticle.

In the earlier mods of the gun sight the reticle and track signal figure 2-7, are illuminated by light piped through lucite rods from lamps mounted in the top of the gun sight case. The reticle is illuminated in the same manner in all mods of the gun sight.

In all mods of the gun sight, power to the reticle lamp is provided automatically through a dimmer potentiometer when the equipment is energized. Power to the TRACK signal lamp is cut in by a relay when the radar goes from SEARCH to TRACK provided the illumination control on the amplifier is on. The reticle consists of two concentric circles: the inner is 4 mils in diameter; the outer, 16 mils.

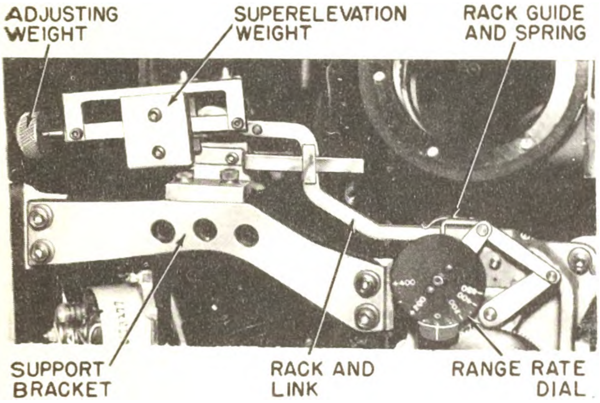


Figure 2-4. Superelevation Computer

Two polaroid filters in the line of sight may be adjusted by the external filter control to supply the desired amount of filtering. When the filter control is in the OUT position, the filters are removed from the line of sight and a clear **compensating plate is put in their place. A stop has been added to later mods to prevent the filter from being turned past its limits.**

The most significant feature of the new telescope used on mods 4 and5 of the gun sight is the inclusion of the telescope eyepiece in the telescope body. This improvement together with the addition of the focusing knob and an eyepiece adapter permit the removal of the gun sight case rear cover without disturbing the lens system of the telescope. This arrangement simplifies final test and alignment procedures.

Figures 2-8 and 2-9 are exploded views of the two types of telescopes now in service in the gun sight.

RANGE MAGNET AND COMPENSATING MAGNET. The range magnet is mounted through the front of the case. On Mods 1, 2, 4, and 5 current is supplied to it by a four-wire connection (Mod 3, five-wire) from the electrical connection and calibration unit.

The coil and core of the magnet are contained in a housing which is secured to a threaded adapter. The adapter is screwed into an adjusting ring on the sight case. The magnet may be shifted vertically and horizontally by loosening the four setscrews in the ring and cinch nut assembly acting on the beveled surfaces of the adjusting ring or by a cam offset adjustment on sights with serial numbers 32 or above.

The air gap between the magnet and the eddy current disk may be adjusted by screwing the magnet within the adjusting ring.

The compensating magnet, figures 2-1, and 2-2, is mounted on the lower right-hand side of the gimbal frame. The coil, connected in series with the range magnet, is mounted on the sight case opposite the cam.

ELECTRICAL CONNECTION AND CALIBRATION UNIT. The electrical connection and calibration unit, figure 2-10, is mounted through the front of the sight case and

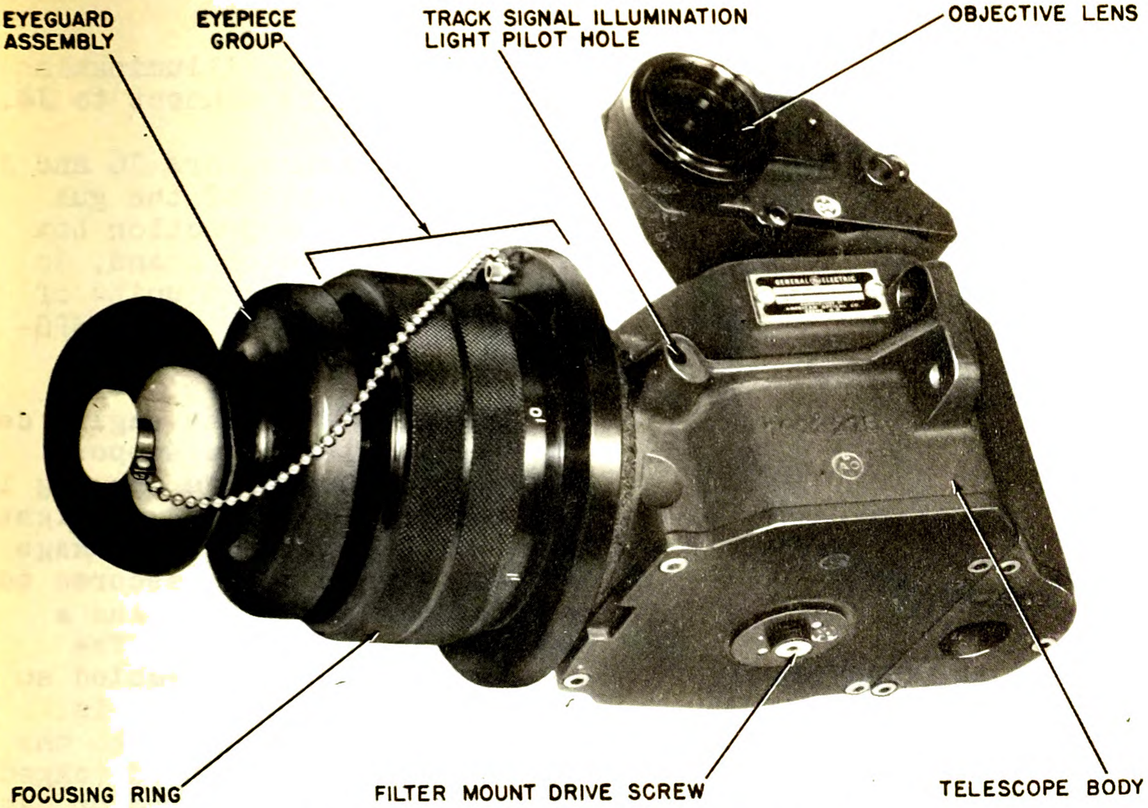


Figure 2-5. Telescope For Gun Sight Mk 31 Mods 1, 2, and 3

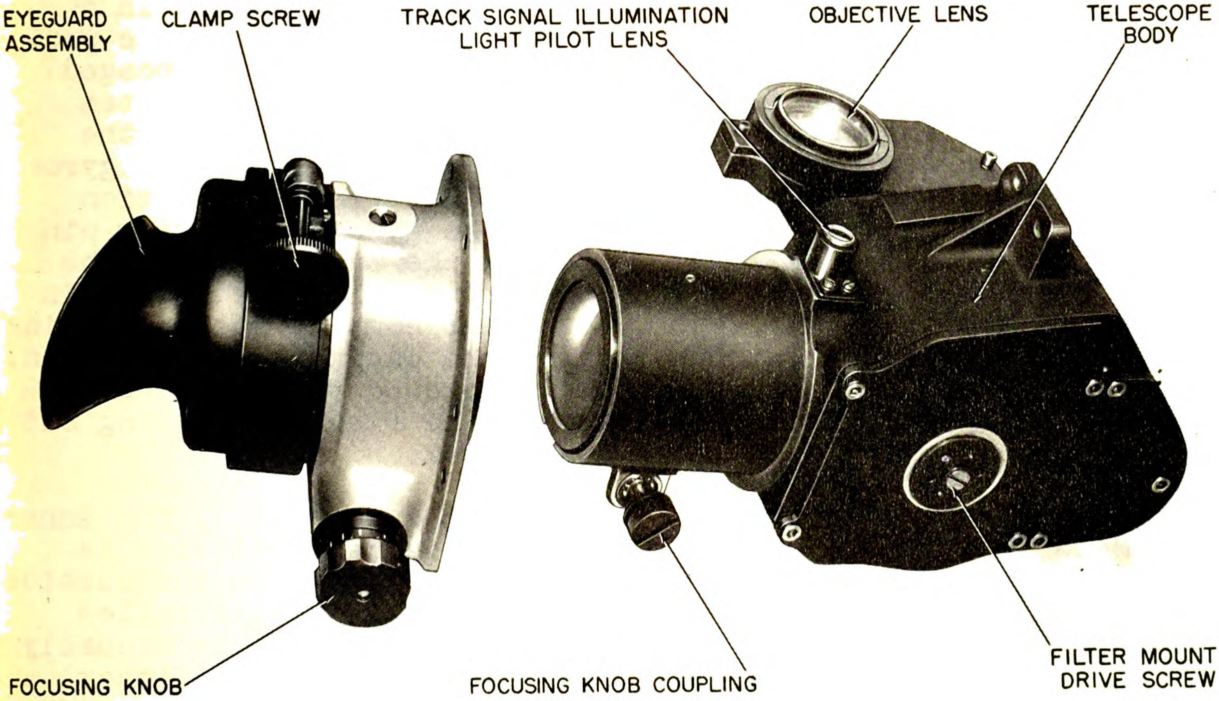


Figure 2-6. Telescope For Gun Sight Mk 31 Mods 4 and 5

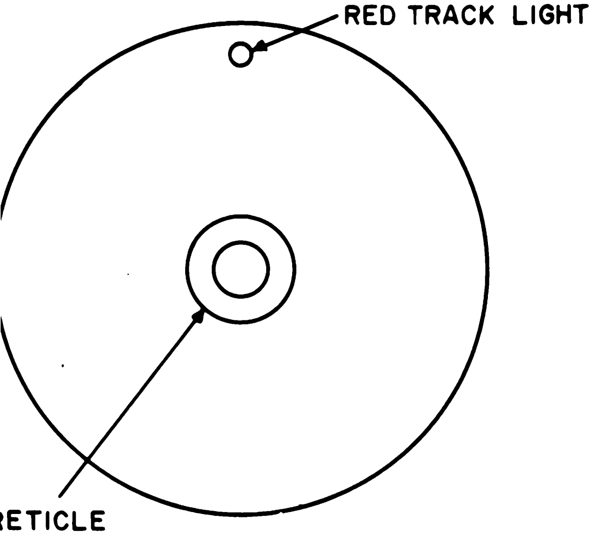


Figure 2-7. Gun Sight Mk 31, Track Signal and Reticle, View Looking into Telescope

ttached to it. The unit con-
ists of two connectors, J6 and
7, on the outside of the case,
ive connectors J1, J2, J3, J4
nd J5 on the inside of the
ase, the thermostat for the
eating element, a temperature
ompensating network for eddy
urrent disk correction, po-
entiometers for sight angle
nd deflection pickoff correc-
ion, and the range magnet
rimmer resistor. The various
nits within the sight case are
onnected to the internal
onnectors. Components on the
imbal frame including the
yroscope, the sight deflection
nd sight angle pickoffs
onnect to J1. In addition, one
ead from the caging servo
otor (Mods 1, 2, 4 and 5)
onnects to J1. The cables from
2, J3, and J5 connect to the
ange rate servo unit, except
ne lead from J2 which connects
o the caging servo motor on
un sight mods 1, 2, 4 and 5.

The range magnet, illumination and heater units connect to J4.

External connectors J6 and J7 connect the units of the gun sight, through a junction box on the gun director stand, to amplifier Mk 121 and units of Radar Set AN/SPG-52 or AN/SPG-52A.

CAGING DEVICE. The caging device is mounted on a support plate secured over an opening in the back cover of the gun sight case. It consists of a linkage system, figure 2-11, secured to a rotatable inner ring and a stationary outer ring. The linkage system is assembled so that when the inner ring is rotated, the links move to the open (engaged) or closed (caged) position. In the closed or caged position, the linkage system grasps a caging pin which is attached to the gyroscope housing and holds the gyroscope in a centered or zero reference position. In the open or uncaged position, the linkage system clears the inner edge of the inner ring permitting the gyroscope full freedom of motion until the gyroscope caging pin strikes the inner edge of the inner ring. Inclined slots in the inner edge of the inner ring catch the caging pin and prevent the gyroscope from precessing around the ring or tumbling out of control.

In gun sight mod 3, the inner ring of the caging device is coupled to a knob on the outside of the cage in the installed position. The knob is manually operated to rotate the inner ring of the caging device and cage or uncage the gyroscope.

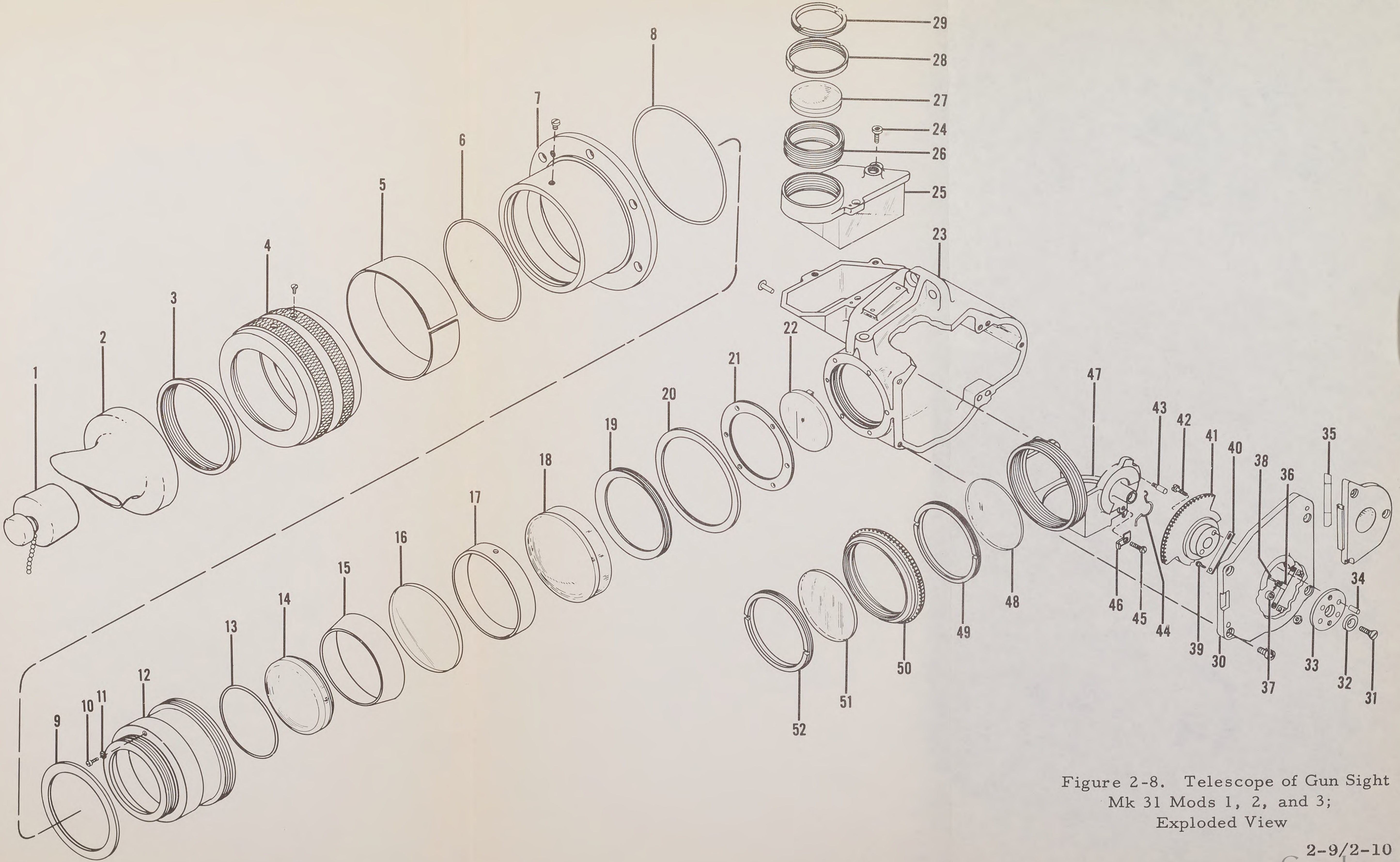


Figure 2-8. Telescope of Gun Sight Mk 31 Mods 1, 2, and 3; Exploded View

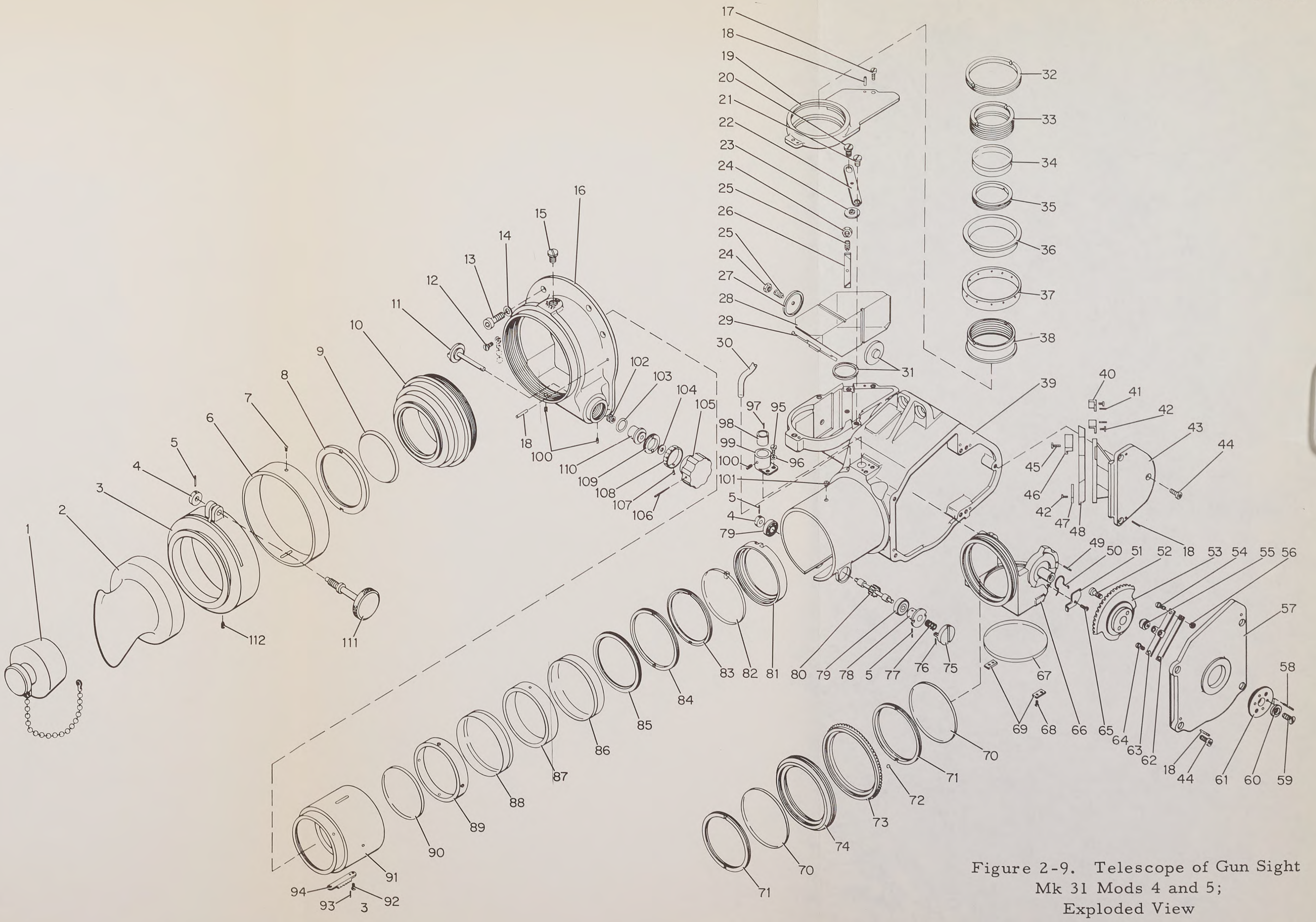


Figure 2-9. Telescope of Gun Sight Mk 31 Mods 4 and 5; Exploded View

In gun sight mods 1, 2, 4 and 5 the inner ring of the caging device is secured to the caging disk, figure 2-12. The disk is coupled through a gear and pinion to the servo motor as shown in figure 2-13. The caging servo motor is operated through a pushbutton switch located on handlebar of the gun director. When the pushbutton is pushed, the servo motor is energized and drives the caging device linkage system to the UNCAGED condition as shown in figure 2-12. When the pushbutton is released or the servo motor is deenergized for any reason, a spring automatically closes the caging linkage to cage the gyroscope. The gyroscope will remain caged under spring load until, either the servo motor is again energized or the manual caging lever on top of the caging servo motor housing, figure 2-13, is turned to the UNCAGED position. The caging lever provides a positive means of uncaging the gyroscope in case of power failure. The position of the caging lever indicates whether the gyroscope is caged or uncaged. The tip end of the caging lever, figure 2-13, can be pivoted downward to engage stop lugs on the servo motor housing and secure the caging device in either the caged or uncaged position.

HEATING ELEMENT. A heating element is cemented to the bottom cover and is connected to a thermostat on the electrical connection and calibration unit. These two components prevent any low temperature extreme of the fluid in the nutation damper. The thermostat turns the heater on when the temperature falls to 50±5 degrees Fahrenheit and turns it off when the temperature rises to 70±8 degrees Fahrenheit.

DESICCATOR UNIT. The desiccator unit, figures 1-3 and 1-4, is a hollow porous bronze cylinder attached to a mounting flange. The cylinder is filled with an indicating desiccant or dehumidifying ingredient. The unit contains a window through which the desiccant can be seen. The unit is inserted through the left side of the sight case and secured to the case.

RANGE RATE SERVO UNIT. The range rate servo unit, figure 2-14, is functionally a part of Amplifier Mk 121, but since it must supply a mechanical output for the superelevation mechanism of the sight, it is physically located within the sight case.

The range rate servomechanism consists of gearing, figure 2-15, driven by a servomotor and driving potentiometers to produce a range rate response (P1), fuze computing (P3), range rate (Tn computing) (P2), and parallax correction (P4) signals. Through a gear and linkage system, it transmits range rate to the superelevation computer and to the range rate indicator dial. Two scribe marks on an adjacent gear permit vernier readings at 0 knots and ± 270 knots range rate. A tachometer, driven by and integral with the servomotor, supplies a stabilizing feedback voltage to one of the signal windings of the first stage of the range rate servo amplifier. Limit switches

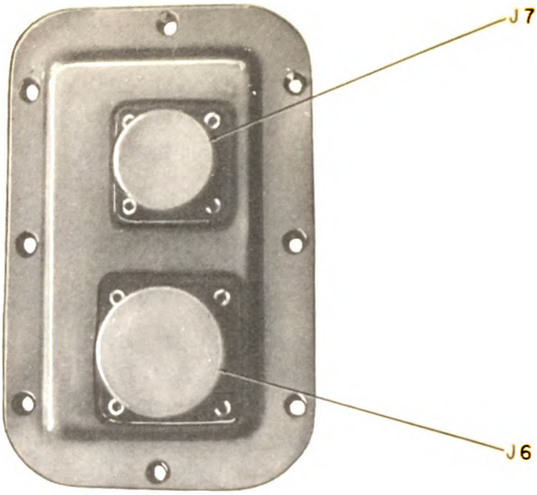
S1 and S2, figure 2-15, prevent the servomotor from overheating when driving into its physical limits and mechanical stops. These switches are normally closed, but S1 opens above 400 knots opening range rate and S2 opens above 650 knots closing range rate. Resistors R2 and R12 are shorted out when both switches are closed, but when either switch is opened, R2 and R12 limit the current in the field of the motor while it is stalled. A slip clutch prevents damage to the gearing if the motor is slewed into a mechanical limit.

AMPLIFIER MK 121

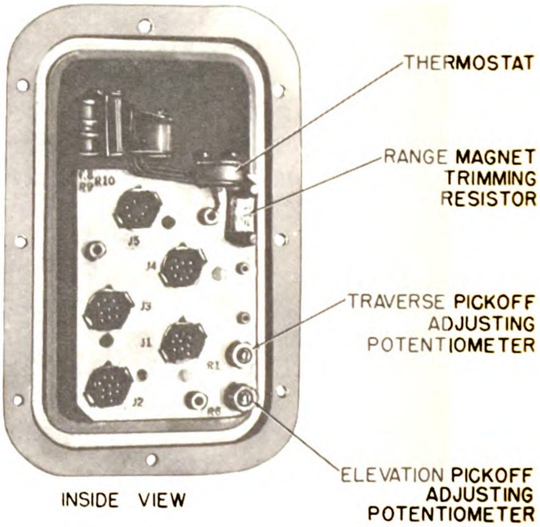
Amplifier Mk 121, figure 2-16, consists of the following major components assembled in a drawer for convenient mounting in a cabinet (computer modulator) of the associated gun fire control system.

Range Rate Servo Amplifier (RRA)
Range Servo Amplifier (RA)
Range Servo Unit (RS)
Magnet Current Supply (MS)
Control Unit (CU)
Test Panel
Power Supply (PS)

RANGE RATE SERVO AMPLIFIER. The range rate servo amplifier, figure 2-17, receives radar range rate signals, amplifies them, and passes them to the control phase of the range rate servo unit motor. A stabilizing voltage from the tachometer of the range rate servo unit is fed back to one of the signal windings of the first stage of the range rate servo magnetic amplifier. Figure 2-19, is a schematic of this unit with the complete servo loop.



OUTSIDE VIEW


THERMOSTAT
RANGE MAGNET TRIMMING RESISTOR
TRAVERSE PICKOFF ADJUSTING POTENTIOMETER
ELEVATION PICKOFF ADJUSTING POTENTIOMETER
R10
J5
J4
J3
J1
R1
J2

INSIDE VIEW

Figure 2-10. Electrical Connection and Calibration Unit

The main units of the servo amplifier are three potted magnetic amplifiers. Each magnetic amplifier unit is built around a saturable core reactor. The potted units of the amplifier are not repairable.

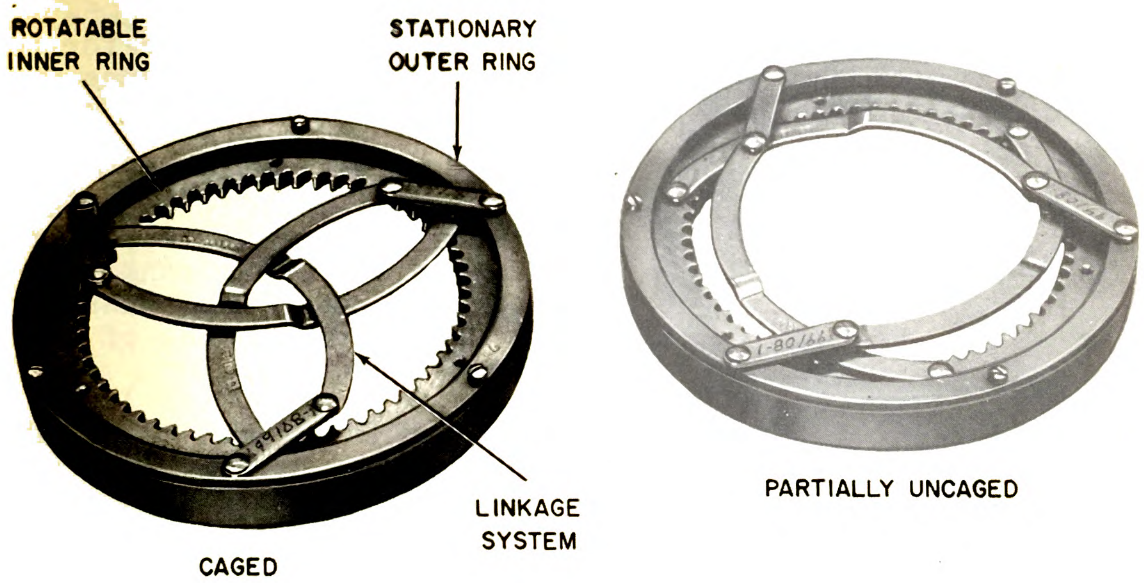


Figure 2-11. Caging Device Linkage System, Assembled Arrangement

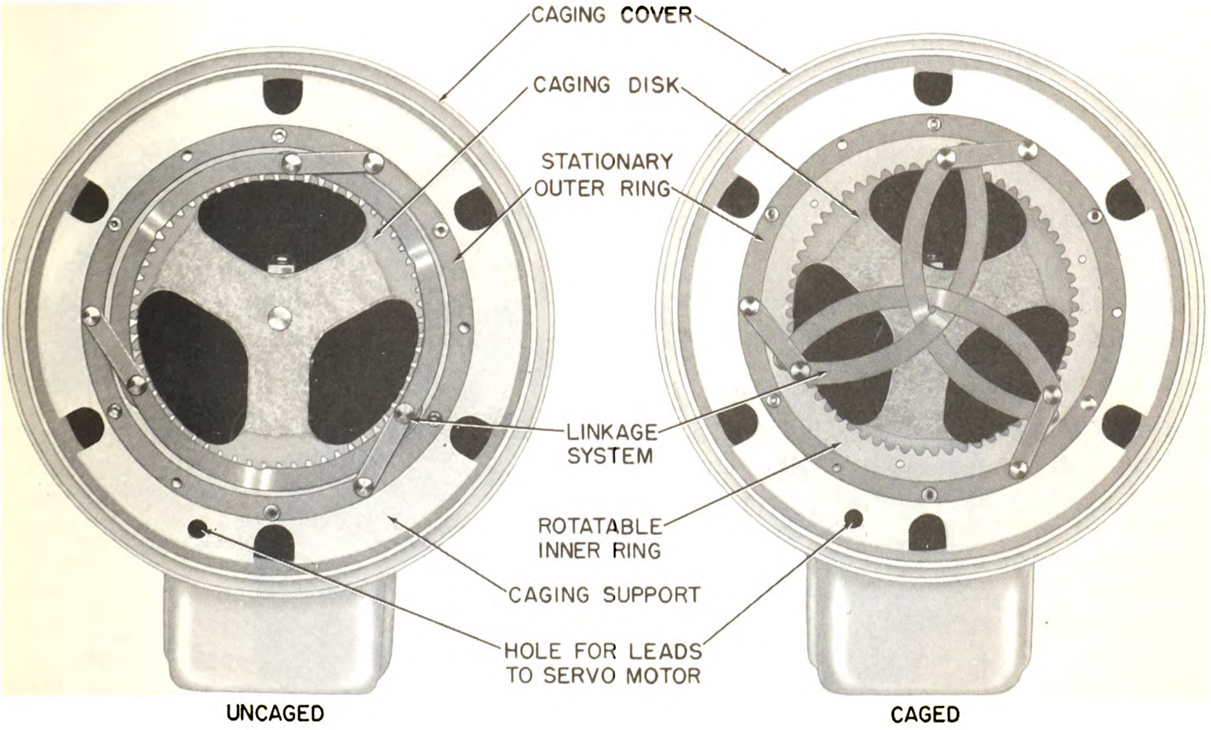


Figure 2-12. Caging Device Linkage System For Gun Sight Mk 31 Mods 1, 2, 4, and 5; Installed Arrangement

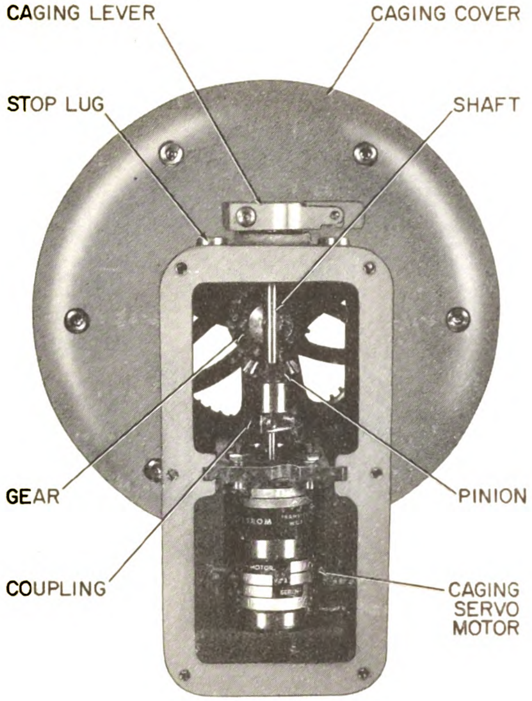


Figure 2-13. Caging Device Servomotor For Gun Sight Mk 31 Mods 1 and 2, After Ordalt 4330, and Mods 4 and 5, Installed Arrangement.

Balance and gain of the amplifier are controlled by P1 and P2 respectively. Chapter 4 gives the procedure for adjusting the gain and balance when required.

RANGE SERVO AMPLIFIER. The range servo amplifier is identical to the range rate servo amplifier. It receives radar range signals, amplifies them, and passes them to the control phase of the range servomotor.

RANGE SERVO UNIT. The range servo unit, figures 2-16 and 2-19, consists of a motor driving potentiometers through gearing to produce signals for fuze time (P1A), range response (P1B), magnet current (P2), parallax correction at five ohms per yard (P3), and parallax correction at one ohm per yard (P4). A dial attached to one of the gears

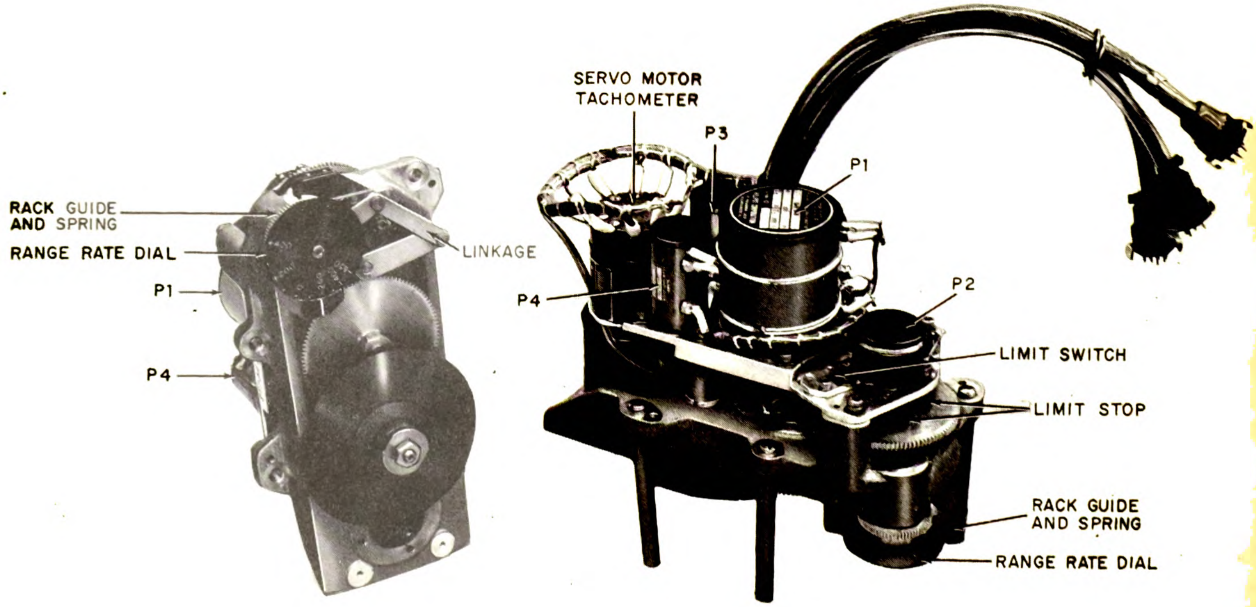


Figure 2-14. Range Rate Servo Unit

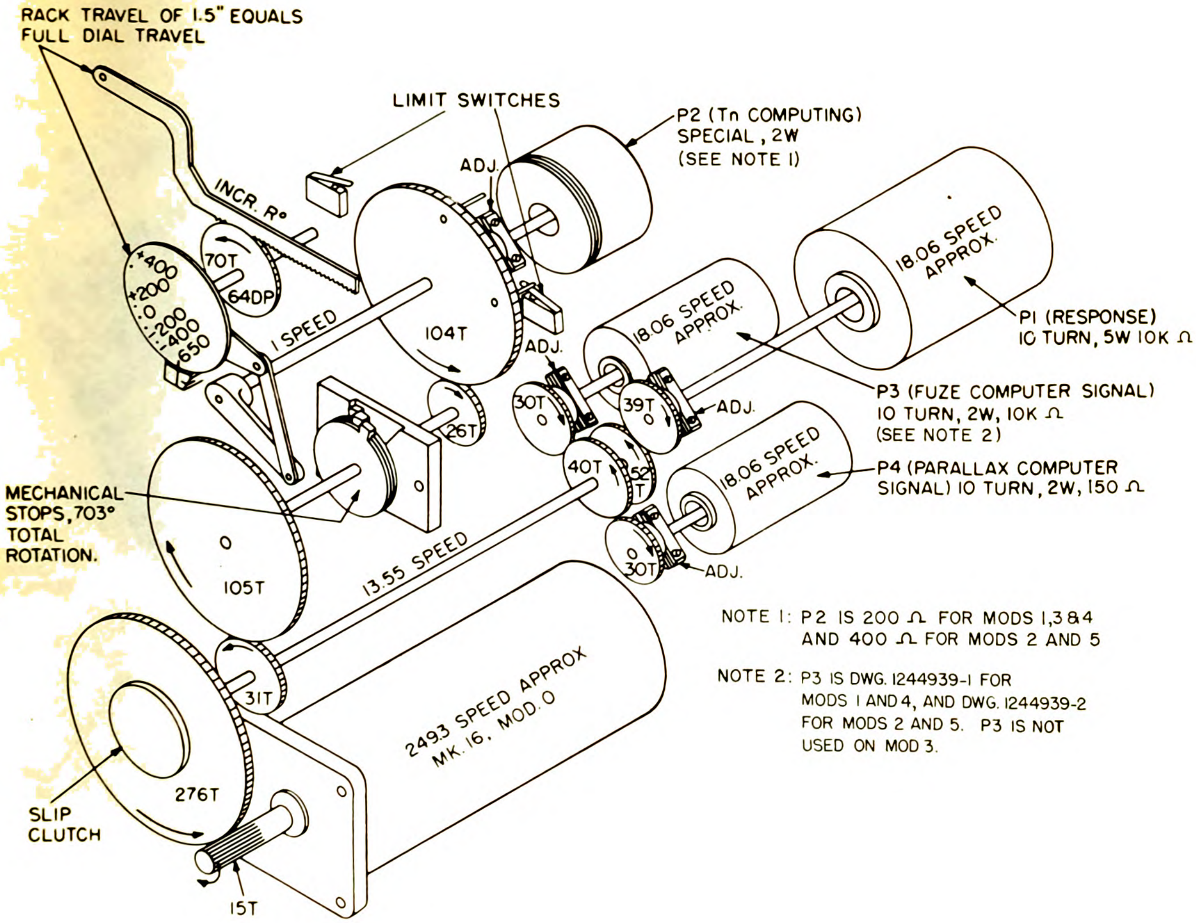

RACK TRAVEL OF 1.5" EQUALS FULL DIAL TRAVEL
LIMIT SWITCHES
P2 (Tn COMPUTING) SPECIAL, 2W (SEE NOTE 1)
ADJ.
INCR. R°
70T
64DP
+400
+200
0
-200
-400
-650
1 SPEED
104T
18.06 SPEED APPROX.
P1 (RESPONSE) 10 TURN, 5W 10K Ω
ADJ.
18.06 SPEED APPROX.
26T
30T
39T
ADJ.
P3 (FUZE COMPUTER SIGNAL) 10 TURN, 2W, 10K Ω (SEE NOTE 2)
40T
52T
18.06 SPEED APPROX.
P4 (PARALLAX COMPUTER SIGNAL) 10 TURN, 2W, 150 Ω
MECHANICAL STOPS, 703° TOTAL ROTATION.
105T
13.55 SPEED
30T
ADJ.
NOTE 1: P2 IS 200 Ω FOR MODS 1,3 & 4 AND 400 Ω FOR MODS 2 AND 5
NOTE 2: P3 IS DWG. 1244939-1 FOR MODS 1 AND 4, AND DWG. 1244939-2 FOR MODS 2 AND 5. P3 IS NOT USED ON MOD 3.
31T
24.93 SPEED APPROX MK. 16, MOD. 0
276T
SLIP CLUTCH
15T

Figure 2-15. Range Rate Servo Unit, Mechanical Schematic Diagram

shows present range in hundreds of yards. A scribe mark on an adjacent gear permits vernier reading every 100 yards.

Figure 2-20 is a gearing diagram of this unit. A tachometer, driven by and integral with the servomotor, supplies a stabilizing voltage to one of the signal windings of the first stage of the range servo amplifier. A limit switch (S1) is provided to prevent the servomotor from driving into its mechanical limits and overheating. This switch is normally closed, but opens below 490 yards and above 7900 yards for amplifier Mods 1 and 2, or below 290 yards and above 4680 yards for Mod 3 amplifier. As shown in figure 2-18, resistors R1 and R2 limit the current in the control field of the servomotor while it is stalled. A slip clutch prevents damage to the gearing if the motor is slewed into a mechanical limit.

MAGNET CURRENT SUPPLY. The range magnet current supply, figures 2-21 and 2-22 is part of

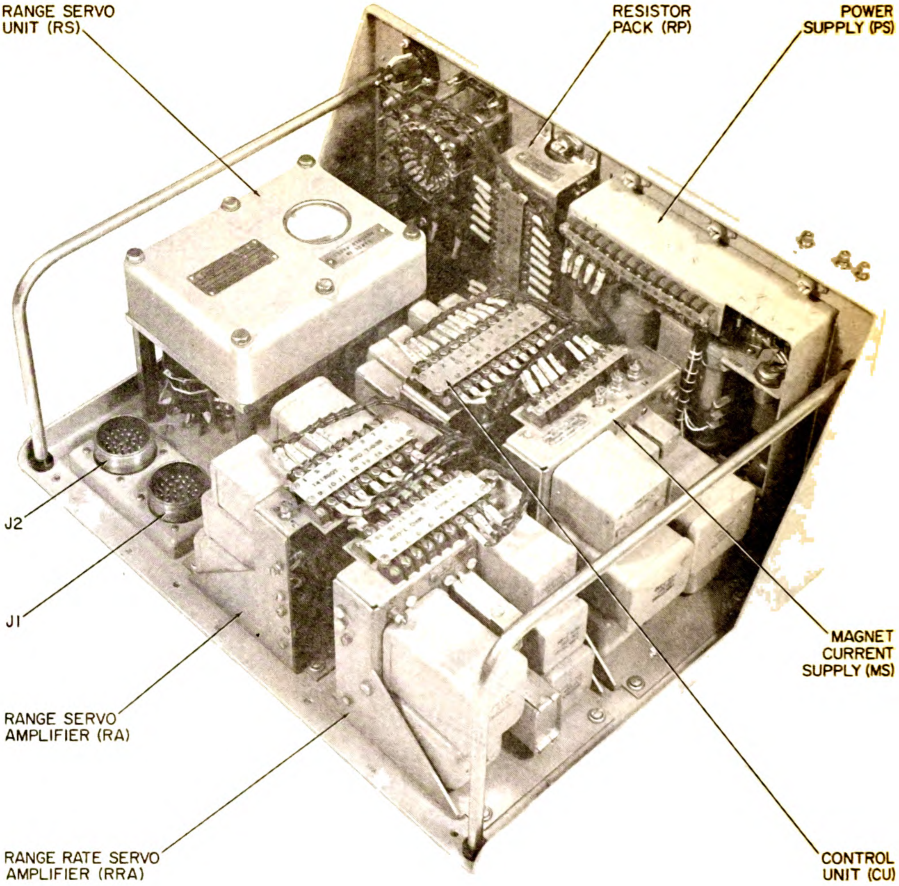

RANGE SERVO UNIT (RS)
RESISTOR PACK (RP)
POWER SUPPLY (PS)
J2
J1
MAGNET CURRENT SUPPLY (MS)
RANGE SERVO AMPLIFIER (RA)
RANGE RATE SERVO AMPLIFIER (RRA)
CONTROL UNIT (CU)

Figure 2-16. Amplifier Mk 121 Mods 1, 2, and 3

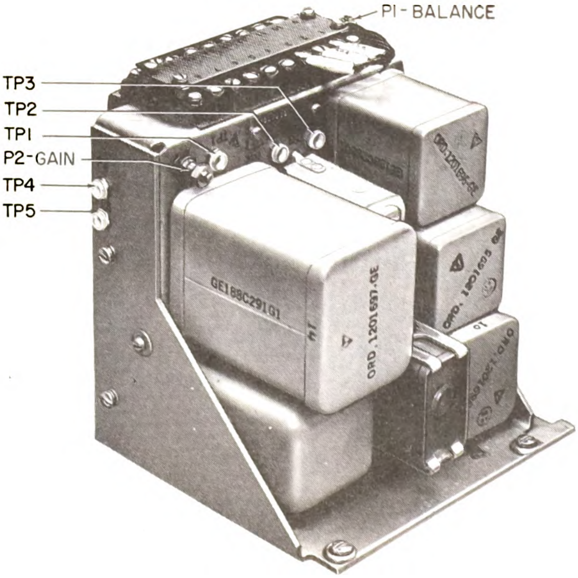
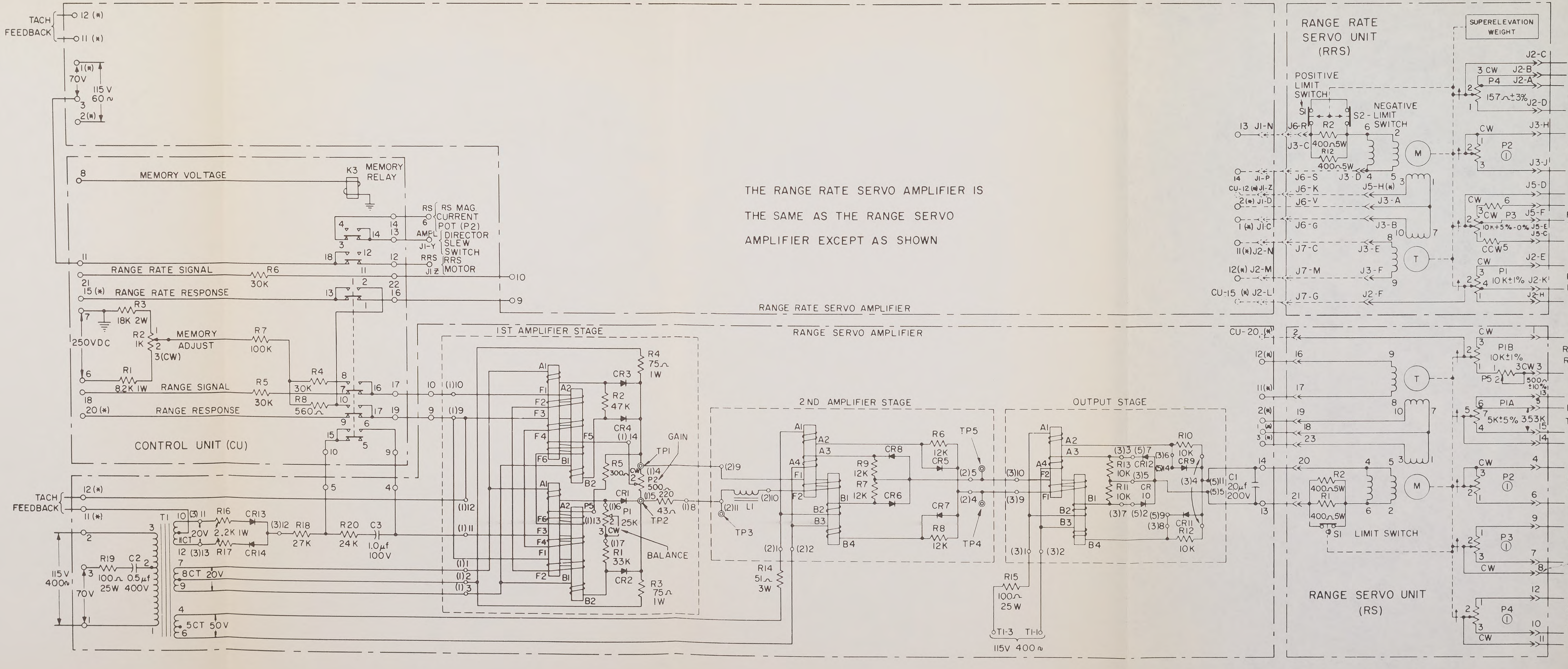


Figure 2-17. Amplifier Mk 121, Servo Amplifier



NOTES: ①

	MOD 1	MOD 2	MOD 3	ACC
RRS - P2	200Ω	400Ω	200Ω	± 5%
RS - P2	1.8K	1.8K	1.067K	± 1%
RS - P3	45 K	45 K	26.67K	± 3%
RS - P4	9 K	9 K	5.33K	± 3%

② NOT USED ON MOD 3

③ TERMINALS MARKED THUS (*) ARE SHOWN TWICE ON THIS DRAWING

④ ARROWS INDICATE DIRECTION OF INCREASING RANGE OR RANGE RATE

⑤ ALL RESISTORS ARE .5 WATT UNLESS OTHERWISE NOTED

⑥ POINTS INDICATED THUS $\overset{(1)\,4}{-\!\circ\!-}$ ARE TERMINALS OF MAGNETIC AMPLIFIER CANS AND DESIGNATE COMPONENT SYMBOL FOLLOWED BY TERMINAL NUMBER

Figure 2-18. Gun Sight Mk 31 Mod 1 and Amplifier Mk 121 Mod 1, Schematic Diagram of Servo Amplifier Loops

Amplifier Mk 121. It provides a current through the range magnet which is inversely proportional to the nominal time of flight. Since the nominal time of flight is a function of range and range rate, the magnet current supply (MCS) must take both of these factors into account. The MCS also provides compensation for variations in the temperature of the eddy current disc in the gun sight and of the magnetic reference unit (MRU). The basic circuit used to control the MCS is shown in figure 2-22. It consists of a current standard or reference (the MRU), an amplifier, a constant resistance leg, and a variable resistance leg.

A voltage (V_a) supplied by the amplifier drives a current (I_t) through the range magnet. I_t is the sum of the current (I_v) through the variable resistance leg (R_v) and the current (I_c) through the constant resistance leg (R_c). The variable resistance leg is composed of the range and the range rate computing potentiometers. The constant resistance leg is composed of the IV switch and the MRU. In order to simplify the circuitry, the IV switch also cuts out part of the range magnet winding for some values of initial velocity.

The MRU monitors I_c. When I_c varies from a predetermined value because of variations within the amplifier, the MRU sends out an error signal (V_s) to the amplifier causing it to drive I_c back toward the predetermined value. When the proper value of I_c is reached, the error signal ceases to flow and I_c stabilizes.

Changes in range or range rate result in a change in R_v. A decrease in R_v increases I_v and I_t while an increase in R_v decreases I_v and I_t.

The slew switch shorts out the range computing potentiometer (P2 of the range servo unit) as shown in figure 2-23. Since P2 forms the largest part of the variable resistance leg of the magnet current loop (R_v, figure 2-22), the magnet current increases to the largest possible value for the existing conditions of range rate and initial velocity setting. This electrically cages the gyro while the sight is slewed. For nominal conditions of range rate and initial velocity, the value of magnet current with the slew switch closed is approximately 68 ma.

The magnet current supply consists of a transistor preamplifier, a magnetic amplifier output stage, and the MRU current standard. The preamplifier has three stages: an AC amplifier; a discriminator; and a DC amplifier.

When the current flowing through the MRU varies from the predetermined amount, an 800-cycle error signal is generated by the MRU. The phase of this signal depends upon whether the variation in the current is larger or smaller than the predetermined amount; the magnitude, on the amount by which the variation in the current is larger or smaller. The error signal is amplified by the AC amplifier (Q1-Q2) and capacity

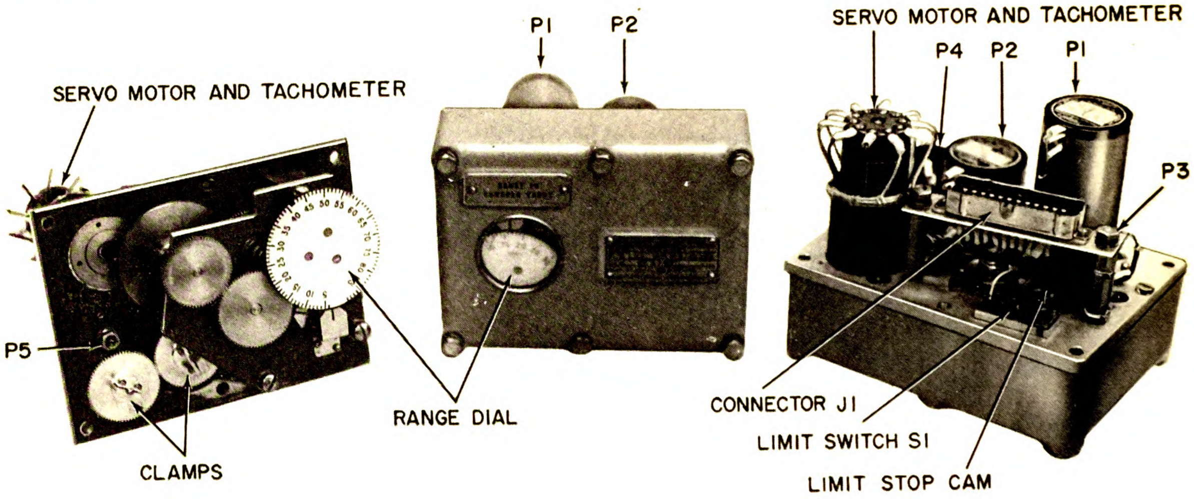
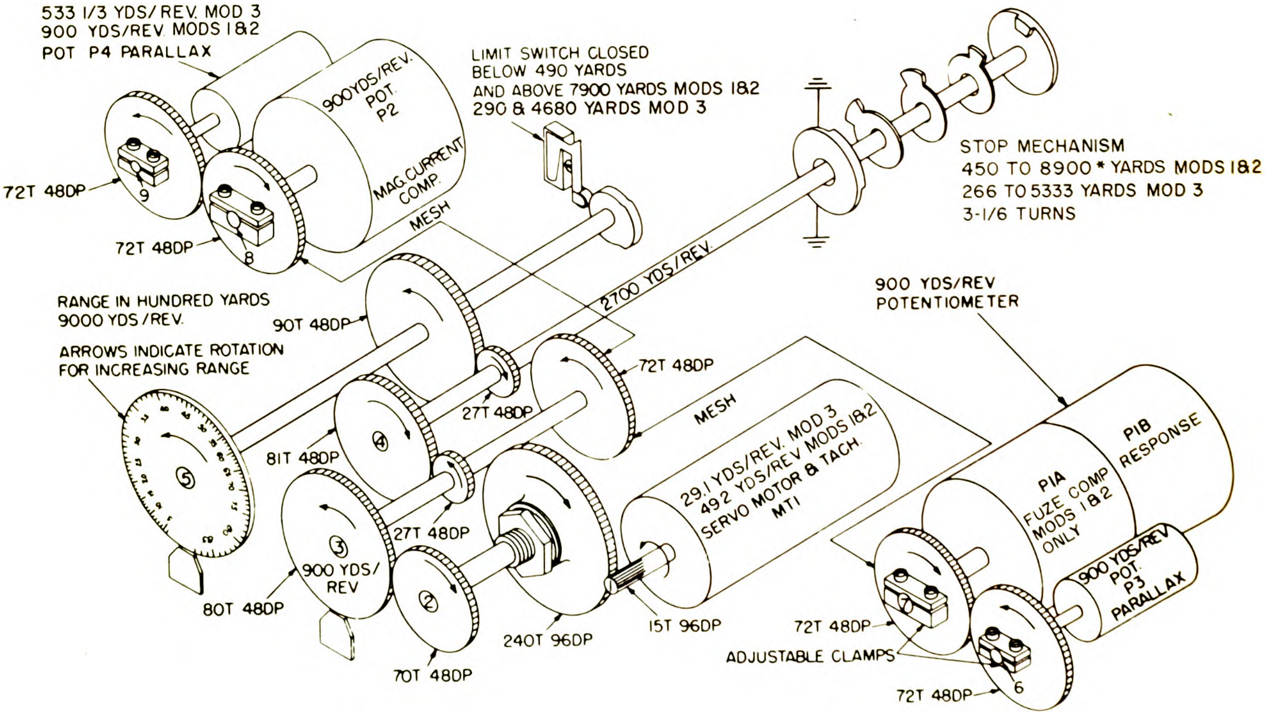


Figure 2-19. Amplifier Mk 121 Mod 1, Range Servo Unit



*8850 YARDS FOR GFCS MK 70 SERIAL NUMBERS 74 THROUGH 81

Figure 2-20. Amplifier Mk 121, Range Servo Unit, Mechanical Schematic Diagram

coupled to the input of the discriminator signal transformer (T3). The output of T3 is fed into the discriminator reference transformer (T2) through a balancing potentiometer (P3). A voltage divider (R31-R34) reduces the output of T3 to the approximate value of the bias on the base of Q3. An 800-cycle reference signal for T2 is obtained from the ripple of the DC amplifier supply. The DC component is removed by capacitor C9. The center tapped output of T2 is fed through a filtering network (R12, C7, C21, R30, C20, R35) to the base of Q3.

When the error signal is zero, no current flows from T2-4. When the error signal is of the same phase as the reference signal, a current follows along the path T2-4, T2-3, CR8, T3-4, T3-3, ground. This causes the bias on the base of Q3 to decrease with a resulting increase in the output of Q3 and in the magnet current. When the error signal is of the opposite phase from the reference signal, a current flows along the path T3-4, CR-7, T2-5, T2-4. This causes the bias on the base of Q3 to increase with a resulting decrease in the output of Q3 and the magnet current.

Filter L1, C25 prevents the 800-cycle components in the load current from interacting with the error signal and giving a false null. A negative temperature coefficient (NTC) resistor (R23) provides compensation for changes in the characteristics of Q3 at high temperatures. An NTC resistor (R33), which changes the value of the voltage divider on the output of T3, balances R23. NTC resistors are special resistors which decrease in resistance as the temperature increases. To prevent exceeding the voltage rating of Q4, capacitor C12 across the signal output of the magnetic amplifier smoothes out pulses fed back from this winding. The input of T3 is parallel tuned with a capacitor (C24) to obtain a better impedance match for the AC amplifier.

Loop gain is set to maintain the MRU current at 5.15±.02 ma under conditions of ± 5 percent line voltage variation, ± 2 percent frequency variation, 0 to 20 degrees Fahrenheit, and expected transistor variations.

CONTROL UNIT. The control unit, figures 2-16, and 2-24, contains the gyro starting relays (K1, K2, and K4) and the memory relay (K3).

The gyro starts and runs on 115-volt, 400-cycle, split-phase power in all single phase input power systems. Since the starting and running impedances of the gyro are different, a relay (K1) alters the circuit when the gyro is up to speed. K1 also prevents the phase splitter from reverting to starting conditions unless the gyro loses too much speed. K2 applies primary power to the magnet current supply when the gyro attains running speed.

When the radar loses a target, the memory relay (K3) disconnects the radar range rate signal and

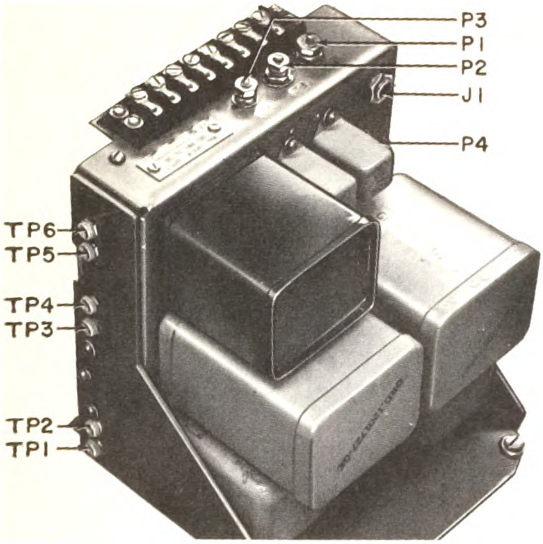


Figure 2-21. Amplifier Mk 121, Magnet Current Supply

the range rate response potentiometer (P1) from the range rate servo amplifier, figure 2-18. All potentiometers and the superelevation rack, stop and remain set at the last known value of range rate. The network C3, R20 in the range servo amplifier is shorted which reduces the low-frequency, open-loop gain of that circuit. The fixed-phase supply to the range rate servomotor is opened and, at the same time, the input to the range servo amplifier is switched from the radar computer-modulator to a fixed-voltage signal from the memory resistor network (R1-R5, R7 and R8) of the control unit and the range response signal is taken from the range rate response potentiometer. The reference voltage for the memory resistor network and the range rate potentiometer is taken from the standard reference voltage supply. The memory lasts for about four seconds. If the target is not reacquired within this time, the range and range rate servos return to clamped position and the gunsight TRACK signal goes off.

TEST PANEL. The test panel, figure 2-25, is on the front of the amplifier drawer. On it are switches for setting initial velocity (S1), for selecting the function of the test panel meter (S2), and for gun sight TRACK lamp illumination (S3). Fuses for amplifier power (F1), fuze computer power (F2), standard reference voltage (F3), a spare fuse (F4), and fuze reference (F5) are also located on the

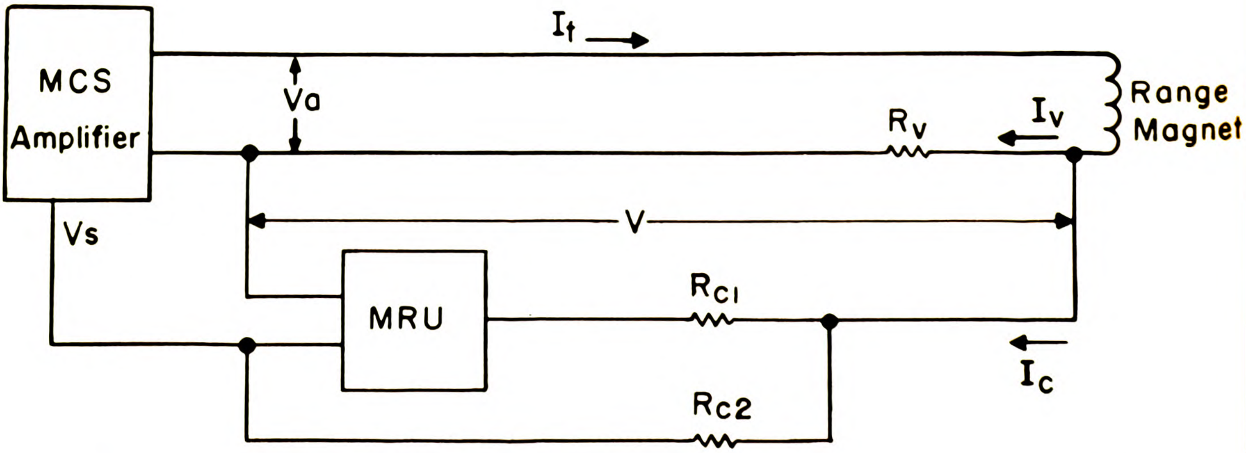


Figure 2-22. Amplifier Mk 121, Block Diagram of Current Loop

① VALUE DIFFERENT FOR EACH SYSTEM
② VALUES DIFFERENT FOR EACH MOD

	MOD 1	MOD 2	MOD 3
R1	112 Ω	140 Ω	191 Ω
R2	160 Ω	161 Ω	129Ω
R3	424Ω	484 Ω	1028Ω
R4	91 K	91 K	91K
R5	220 K	220 K	240K
R6	82 K	75 K	68K
R7	43 K	33 K	39K
R8	22 K	24 K	24K
R9	18 Ω	15.5 Ω	14.5Ω
R10	18 Ω	15.4 Ω	14.5Ω
R11	18 Ω	15.5 Ω	14.5Ω
R12	18 Ω	15.4 Ω	14.5Ω
R13	18 Ω	15.5 Ω	14.5Ω
R14	521 Ω	50 Ω	NOT USED IN THIS MOD
R15	571 Ω	102 Ω	
R16	622Ω	154 Ω	
R17	674Ω	208 Ω	
R18	721Ω	258 Ω	
R19	769Ω	309 Ω	
R20	818Ω	360 Ω	
R21	867Ω	413 Ω	
R22	918 Ω	467 Ω	
R23	969Ω	522 Ω	
R24	1021Ω	578 Ω	
R28	472Ω	——	

③ MS-8 IS GROUND

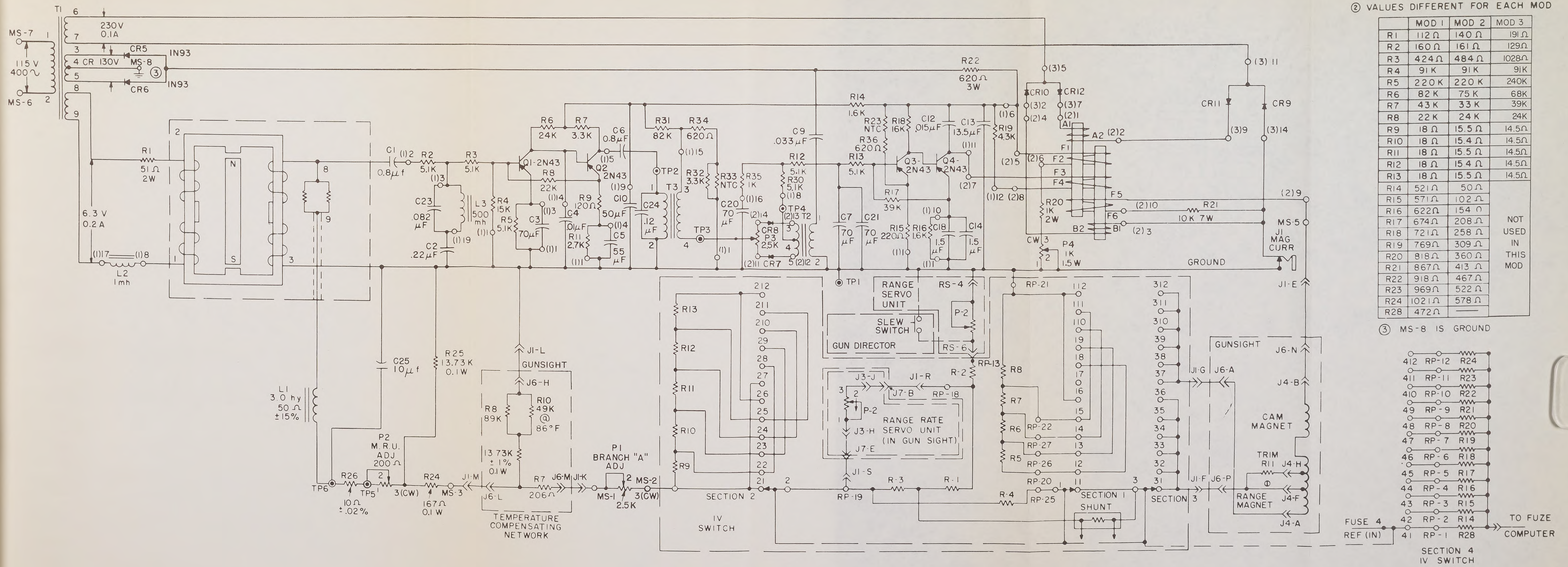
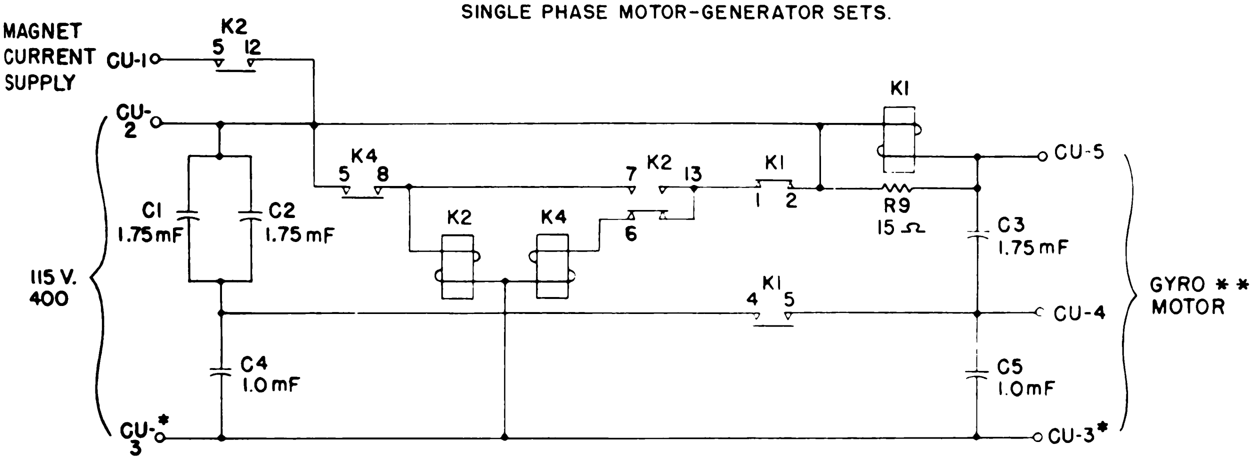


Figure 2-23. Amplifier Mk 121 Mod 1, Schematic Diagram of Magnet Current Loop



K1 - GYRO START RELAY

K2 - MAGNETIC CURRENT INTERLOCK RELAY - 3 SEC. DELAY ON DROP OUT

K4 - THERMAL RELAY - 5 SEC. DELAY ON PICK UP

* APPEARS TWICE

** CU-4 OUTPUT IS USED ONLY IN INSTALLATIONS UTILIZING SINGLE PHASE MOTOR-GENERATOR SETS.

Figure 2-24. Amplifier Mk 121, Partial Schematic of Control Unit

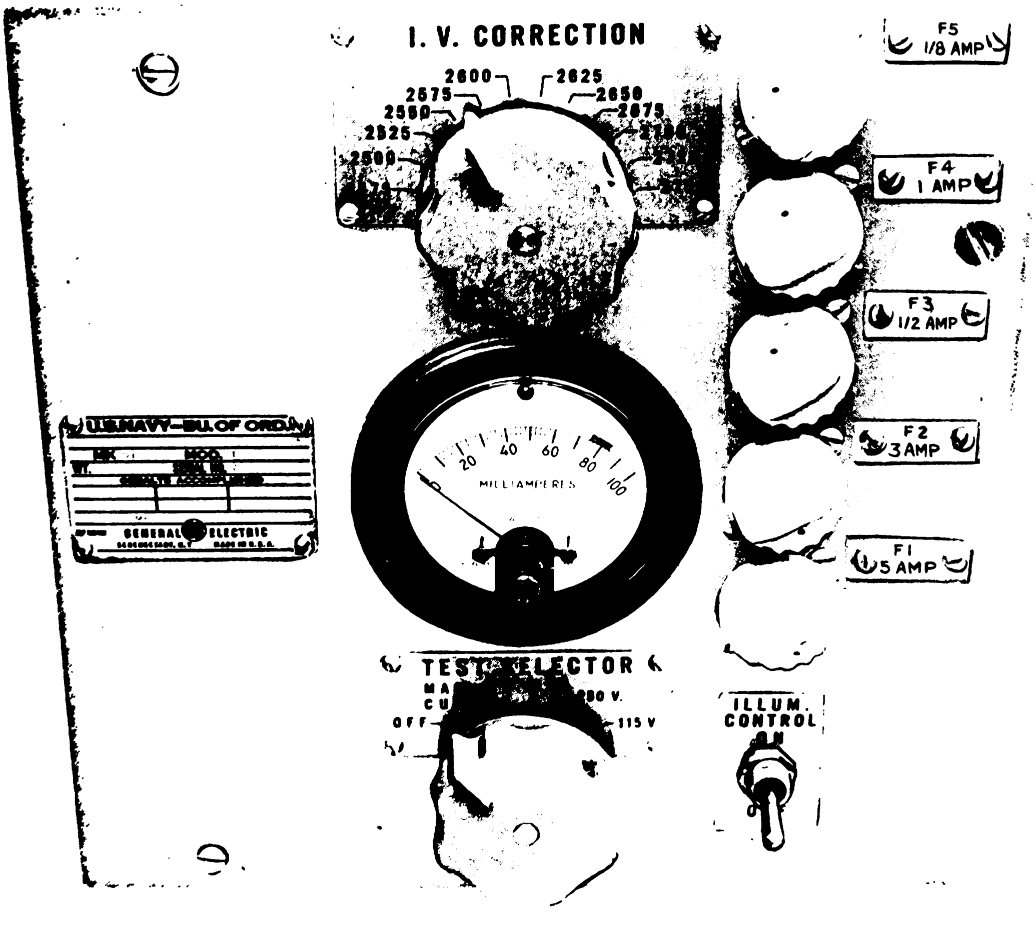


Figure 2-25. Amplifier Mk 121, Test Panel

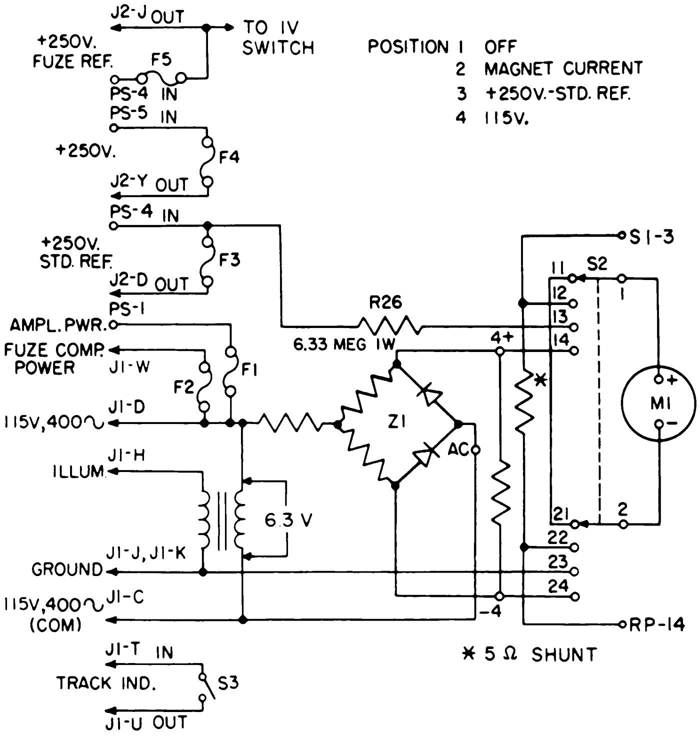


Figure 2-26. Amplifier Mk 121, Test Panel, Partial Schematic Wiring Diagram

SYMBOL	COMPONENT
(1)	AR1 PREAMPLIFIER
(2)	AR2 BOOSTER AMPLIFIER
(3)	AR3 TRANSFORMERS AND RECTIFIER
(4)	F1 FILTER

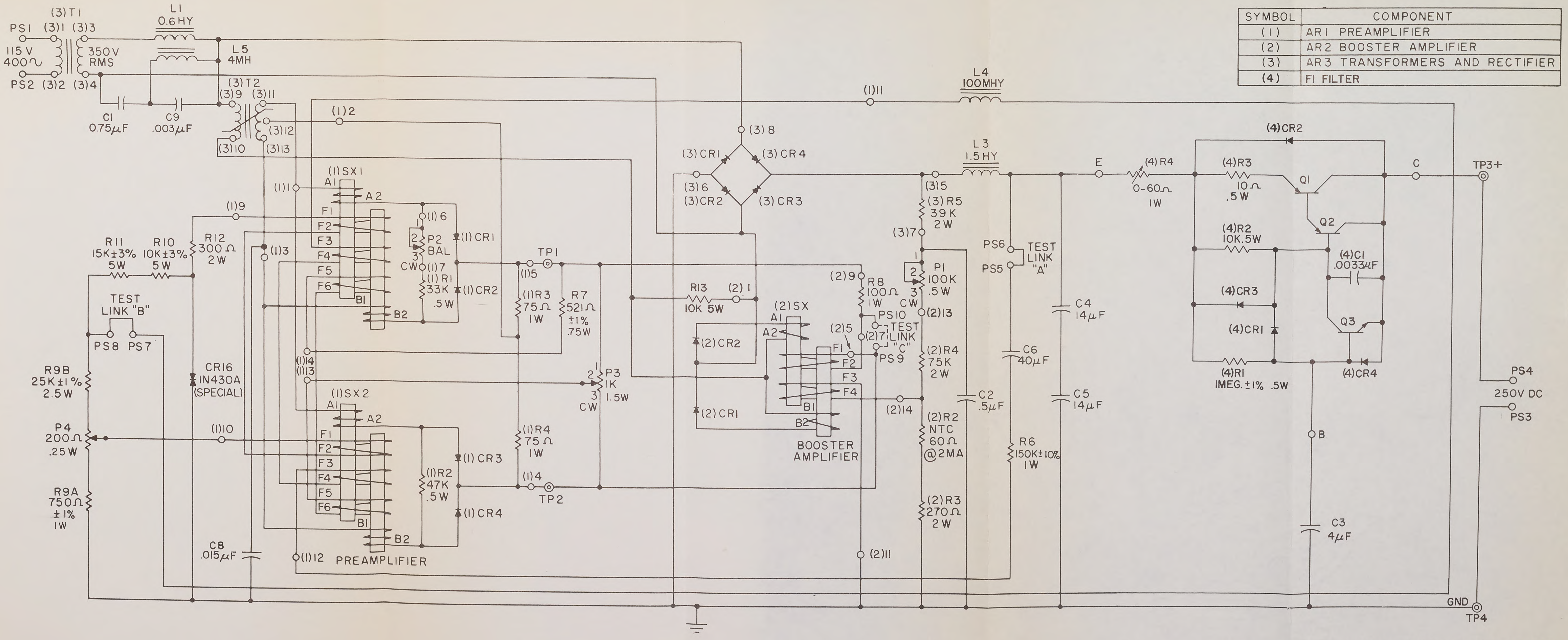


Figure 2-27. Amplifier Mk 121, Schematic Diagram of Power Supply

panel. Figure 2-26 is a partial schematic of this unit.

Initial velocity is set into the system by a 12-position, four-gang rotary switch (S1). A removable resistor pack, controlled by S1, may be easily changed to modify the system for different ballistics and initial velocities. Nominal values for the various type guns are: 2650 foot-seconds for 3"/50 caliber, rapid fire; 2500 foot-seconds for 5"/38; and 2800 foot-seconds for 40 mm. Compensation is provided in steps of 25 foot-seconds from a velocity 100 foot-seconds above the nominal value to 175 foot-seconds below the nominal value.

The test panel meter may be set to read magnet current (position 2), standard reference voltage (position 3), and 400-cycle line voltage (position 4) by turning the function selector switch (S2) to the proper position. Position 1 of this switch is OFF.

POWER SUPPLY. The power supply, figures 4 and 26, is located in the forward left-hand corner of the amplifier drawer next to the test panel. It consists of a zener diode voltage standard, with its associated sensing circuit, a magnetic booster amplifier, and a magnet pre-amplifier. The power supply supplies regulated + 250-volt DC power to manual control circuits, radar calibration circuits, excitation of the range and range rate response potentiometers, and reference voltage for the fuze computer. This unit is shown schematically in figure 2-27. The input voltage of 115 volts, 400 cycles is fed into a stabilizer and the booster amplifier. The output of the stabilizer is essentially a square wave AC voltage supplying the booster amplifier (AR2) and the full-wave rectifier (CR1-4). The output of the booster amplifier is controlled by a circuit which senses changes in output voltage. The sensing circuit is a resistance bridge employing a zener reference diode (1N430A) as a voltage standard. The error signal from the sensing circuit is amplified by the pre-amplifier (AR1). The pre-amplifier amplifies the error signal to a level which will drive the booster amplifier and regulate the power supply output. Negative feedback is supplied to the pre-amplifier through a rate network. Pre-amplifier positive feedback boosts loop gain. Distribution is shown in figure 2-28.

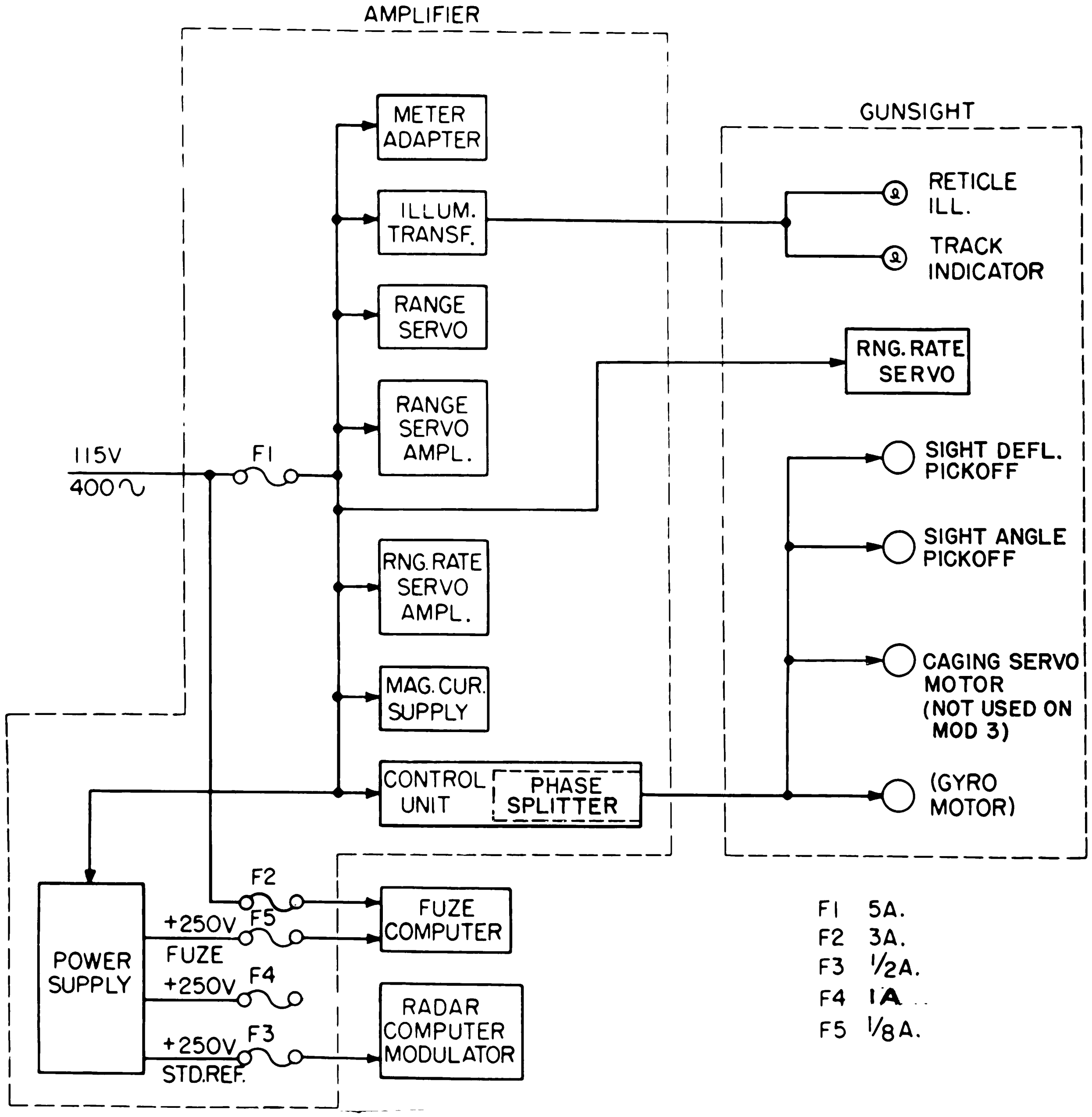


Figure 2-28. Amplifier Mk 121, Power Distribution

Chapter 3

OVERHAUL AND REPAIR

PREPARING FOR DISASSEMBLY

Before attempting to dismantle the gun sight or the amplifier, the repairman should become familiar with the equipment. A study of chapters 1 and 2 of this manual will assist him in fault finding and repair.

A list of test equipment and special fixtures required is contained in Appendix A. A tabulation of drawings and lists of drawings, in Appendix B; and a compilation of pertinent unit schematics and wiring diagrams (Bureau of Naval Weapons drawings), in Appendix C.

1. All parts which are removed should be marked to facilitate reassembly. When dealing with balanced units such as the gyro, this is mandatory.
2. After components have been removed and cleaned, keep them covered as protection against dust and other foreign matter.
3. Place small parts in containers near their associated components.
4. Be careful not to damage shims or gaskets when removing them.
5. Make sure that replacement nuts, bolts, etc., are made of corrosion resistant material.

PRECAUTIONS

1. When removing or reinstalling the caging device or the rear cover with the caging device in place, always make sure that the device is in the UNCAGED position and that the caging pin is centered, otherwise the caging pin can be bent.
2. Do not start the gyro with the caging device removed or in the UNCAGED position or with the range magnet current on and the nutation damper removed. If it is necessary to start the gyro with the caging device removed, hold the caging pin to keep the gyro centered. With the caging device removed and the gyro running, the sight should be moved only if the dummy caging device is attached.
3. When the spiral connectors are to be removed from the sight units, the shipping bracket (SA 2312211) should be attached to prevent damage to the connectors and removed only after reinstallation.

OVERHAUL AND REPAIR OF GUN SIGHT MK 31

The gun sight should be given a complete overhaul about every 20 months or after 1000 hours of operation. The overhaul will normally consist of a complete breakdown and inspection of the equipment. If repairs are required between overhaul periods, appropriate portions of the following instructions may be used.

DESICCATOR UNIT (FIGURES 3-1 AND 3-2).

1. Remove the four screws (hex soc hd #10-24x5/8) and withdraw the unit from the sight case.
2. Visually check the desiccator and replace it with a fresh unit if the desiccant has turned pink.
3. Replace the desiccator unit and purge and charge the gun sight case. Refer to Chapter 4, Purging and Charging.

    CAUTION: During installation pay special attention to the heater leads to prevent them from interfering with movement of the gimbal.

LEFT COVER (FIGURES 3-1 AND 3-2).

1. Remove the six screws (hex soc hd #10-24x5/8) that secure the cover to the case.
2. Pry loose from the case using the pry hole at the after corner of the plate.

ELECTRICAL CONNECTION AND CALIBRATION UNIT (FIGURES 3-1 AND 3-2).

1. Remove the eight screws (hex soc hd #10-24x5/8) that secure the unit to the case.
2. Pry the unit loose using the pry holes on the upper and right sides.
3. Remove the unit from the case and disconnect the five plugs. Be sure to unlock the locking devices on the plugs before trying to take them out. In reassembly, the plugs and sockets may be easily matched by matching colors. Make sure the plugs are locked in place.

TELESCOPE EYEPIECE GROUP (FIGURES 2-8, 2-9, 3-1 AND 3-2).

1. On Gun Sight Mods 1, 2 and 3, the telescope eyepiece, including the eyeguard assembly can be removed from the rear cover of the gun sight case by removing six screws (hex soc hd #10-24x5/8).
2. On Gun Sight Mods 4 and 5, the telescope eyepiece is contained in the telescope body and only the adapter which supports the eyeguard assembly is attached to the rear cover of the gun sight case. The adapter can be removed from the rear cover by removing the ten screws (hex soc hd #10-24x5/8). With the focusing knob set at approximately the zero position, pull gently on the eyepiece adapter. If the eyepiece adapter does not

come off freely, turn the focusing knob slightly in either direction.

NOTE: A slight adjustment of the focusing knob may be necessary to disengage the tongue on the focusing knob from the slot in the coupling on the focusing gear shaft.

3. When installing the eyepiece adapter, care must be taken to align the tongue on the focusing knob shaft with the slot in the coupling on the focusing gear shaft.

NOTE: Although the current revision of drawing 2094690 shows the eyepiece adapter dowelled to the rear cover of the gun sight case, this procedure has been proven unnecessary and eliminated.

GUN SIGHT CASE REAR COVER (FIGURES 3-1 and 3-2). If only the rear cover and/or the caging device are to be removed from the gun sight case and the gyroscope and linkage unit is not to be removed, it is important to locate the zero position of the gun sight on the test stand before removing the main cover or caging device. The zero reference position is found by caging the gyro and moving the sight case on the test stand until the zero point of the sight scale is visible through the telescope. If the sight case is clamped to the test stand in the zero position, the caging device can be realigned after overhaul by simply moving the gun sight case rear cover (mod 3) or the caging support (mods 4 and 5) until the zero position on the sight scale is visible through the telescope. Should the preceding not be followed or the gyroscope and linkage unit be removed from the sight case during overhaul, the alignment procedure in chapter 4 must be followed.

1. Remove the eyepiece group, in accordance with instructions given in this chapter prior to removing the gun sight case rear cover.

2. Remove the 16 screws (hex soc hd #10-24x5/8) that secure the rear cover to the sight case.

3. Uncage the gyroscope (manually on gun sight mods 1, 2, 4 and 5).

4. Remove the rear cover carefully.

NOTE: On gun sight Mods 1, 2, 4 and 5 the caging servomotor housing cover must be removed and the servomotor leads disconnected before the rear cover or caging cover can be removed.

NOTE: The caging linkage may be inspected without further disassembly, however, a thorough inspection of the caging device requires that it be removed from the gun sight case rear cover.

CAUTION: The gyroscope should not be run with the rear cover and gyro caging device removed unless the gyro retaining ring (SA2312203) is attached to the gun sight case.

5. The rear cover on gun sight Mods 1, 2 and 3 may require redowelling if the gyroscope and linkage unit is removed from the sight case.

RANGE RATE SERVO UNIT (FIGURES 3-1, 3-2, 3-3, AND 3-4).

1. Remove the two screws (hex soc hd #4-40 x 5/16) that secure the rack guide and spring.
2. Slide the rack guide and spring from their dowels; move the range rate unit until it indicates +400 knots; complete removal of the rack guide and spring. Be very careful to avoid bending the rack and its associated linkage. If the rack or the linkage is bent, misalignment will result.
3. Remove four screws (hex soc hd #10-24 x 3/4) that secure the unit to the inside of the case.
4. Drop the unit slightly to disengage the superelevation link and remove the unit.
5. Remove nut, washer, and lockwasher holding the slip clutch to the shaft of the 276-tooth gear, figure 3-4.
6. Remove the slip clutch.
7. Remove 276-tooth gear and the 31-tooth gear.
8. Loosen screws (hex soc hd #4-40 x 1/4) to the adjusting clamps on the shafts of P2, P3, and P4.
9. Remove screws (hex soc hd #4-40 x 1/4) to the mounting clamps on potentiometers P1, P2, P3, and P4. Remove the potentiometers.
10. Remove the servomotor-tachometer.
11. Remove 30-tooth gears from P3 and P4.
12. Drive pin from the 40- and 52-tooth gears.
13. Drive pin from the adjusting clamp on the shaft of the 104-tooth gear and from the 104-tooth gear.
14. Drive the pin from the crank arm on the shaft of the 104-tooth gear.
15. Remove retaining ring holding the dial assembly on its shaft.
16. Pull dial assembly, crank, and spacer from their shafts.
17. Remove four screws (2 hex soc hd #6-32 x 1/2 and 2 hex soc hd #6-32 x 3/4) and lockwashers which attach the plate to the frame.
18. Carefully remove plate from frame.
19. Remove the 104-tooth gear, spacer, and adjusting clamp from the shaft of the 104-tooth gear.

Figure 3-1. Gun Sight Mk 31 Mod 3, Assembly Drawing

Figure 3-2. Gun Sight Mk 31 Mods 4 and 5, Assembly Drawing

20. Remove the 40- and 52-tooth gears from their shaft.

21. Remove retaining ring and spacer from the shaft of 70-tooth gear. Slide shaft to the left and remove it from frame.

22. Remove 104-tooth gear shaft from frame by sliding it to the left.

23. Remove the 40- and 52-tooth gear shaft by sliding it to the left.

    NOTE: In removing the shafts, the left-hand bearing, figure 3-4, will come out with the shafts. Other bearings on these shafts are held in place by retaining rings and may be removed for cleaning and inspecting by removing the retaining rings.

24. Remove two screws (hex soc hd #8-32 x 1/2) and lockwashers holding stop mechanism in place.

25. Remove stop mechanism from frame by sliding it to the left.

26. Range rate dial and gear assembly may be further disassembled for inspection or repair as required.

27. In reassembling, reverse the disassembly procedure. Replace all worn or defective parts. Follow normal procedures in determining shaft end play and backlash in the gear train and in installation of dowel pins and other components.

28. To protect the stops in the potentiometers, re-engage the potentiometers with free motion centered on the operating range in accordance with instructions in chapter 4.

29. Make sure that switches S1 and S2 are set to trip at equal distances from the range rate positive stop.

30. Make sure that the slip clutch is adjusted to slip at about three inch-pounds.

SUPERELEVATION COMPUTER (FIGURES 3-5 AND 3-6).

1. Move the superelevation weight outboard to clear the two screws securing the guide rail to the bracket.

2. Remove the screw (pan hd #4-4 x 1/4), washer and lockwasher from the forward end of the superelevation shaft.

3. Loosen nut on the after end of the shaft.

4. Using a screw driver, back the shaft out. Disassembly of the superelevation computer and gimbal bracket is now complete for normal overhaul purposes. Make a careful inspection of the various parts of these units, especially bearings, shafts, and sliding surfaces. If further disassembly is required see BUWEPS 689785 and 689789.

GYROSCOPE AND LINKAGE UNIT (FIGURES 3-1, 3-2, AND 3-5).

1. **If the electrical connection** and calibration unit has not already been removed, unplug connector J1. Be sure to unlock the locking devices on the connector before trying to remove it.

2. Remove screws (hex soc hd #10-24 x 1/2) that secure the bottom cover to the sight case.

3. Remove cover and disconnect leads to the heater which is attached to the cover.

4. Remove four screws (hex soc hd #8-32 x 3/8), lockwashers, and clamps which attach the nutation damper to the gimbal.

5. Remove the nutation damper.

6. Attach shipping bracket (SA2312211) to the sight deflection spiral connectors to prevent them from being damaged.

   NOTE: The shipping bracket should not be removed until after the gyroscope and linkage unit has been reinstalled in the sight case.

7. Remove the ten screws (hex soc hd #10-24 x 5/8) that secure the upper and lower bearing support brackets to the sight case.

8. Work the gyroscope and linkage unit off of the dowels securing the support brackets to the case. Make sure that both brackets come off at the same time.

9. Lift the unit from the sight case and place it in the gyro and gimbal balancing fixture (SA2311453), Chapter 4.

   CAUTION: Use extreme care in handling the unit with the brackets free to prevent the bearings and spiral connectors from becoming damaged.

SIGHT DEFLECTION SPIRAL CONNECTORS AND PICKOFF (FIGURE 3-5).

1. With shipping bracket (SA2312211) attached, proceed to disconnect all electrical leads.

2. Remove the self-locking nut (#4-40) from the end of the pickoff shaft.

3. Remove the two screws (12-Z-1007-1) securing the lower spiral connector support bracket (dwg 718242) to the gimbal frame. Slide the bracket off of the

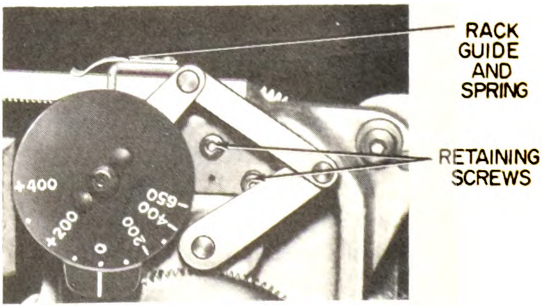


Figure 3-3. Gun Sight Mk 31, Rack Guide and Spring of Range Rate Servo Unit

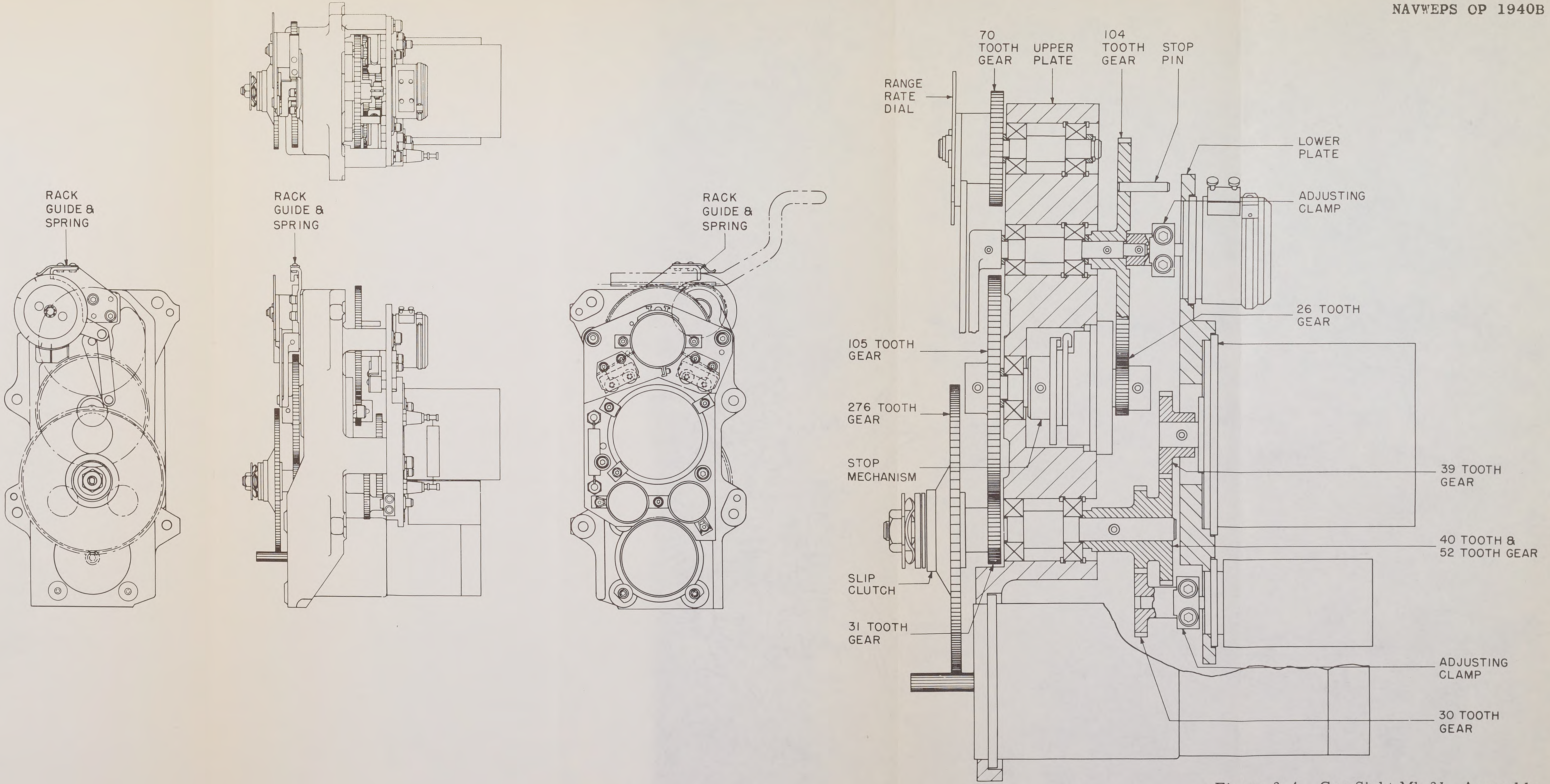
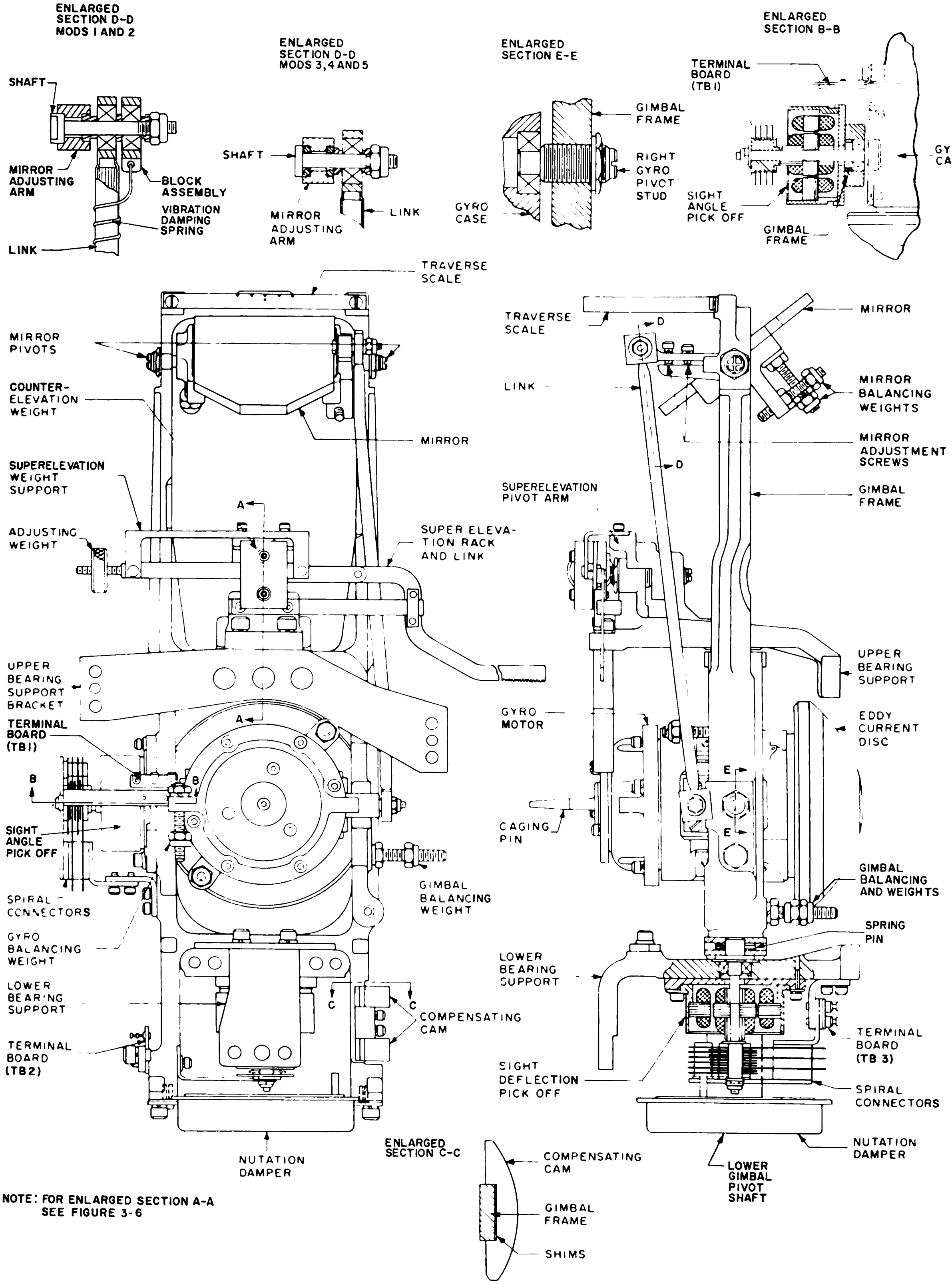


Figure 3-4. Gun Sight Mk 31, Assembly Drawing of Range Rate Servo Unit



NOTE: FOR ENLARGED SECTION A-A SEE FIGURE 3-6

Figure 3-5. Gun Sight Mk 31, Gyro and Linkage Unit Assembly

pickoff shaft.

4. The spiral connectors can now be removed by removing the two screws (12-Z-1007-2) which hold the two spiral connector support brackets (dwgs 718240 and 1413886) and terminal board TB3 together.

5. Slide the spiral connectors, the spacer, and the pickoff rotor off the pickoff shaft.

6. Remove the two screws (12-Z-1007-16) which hold washers (dwg 1022206) overlapping the flange of the stator housing.

7. Remove the stator housing and housing base.

   NOTE: The housing base can be removed after the lower bearing support has been removed.

8. After the gyroscope unit has been disassembled, the pickoff shaft can be removed by driving out the spring pin which holds it to the lower crossbar of the gimbal frame. If the shaft is not worn or pitted, it may not have to be removed.

9. If the housing base is to be replaced, the following alignment steps must be performed.

   a. Complete the Upper and Lower Bearing Support Bracket disassembly as outlined in this Chapter.

   b. Mount the upper bearing support and bracket and the lower bearing support in the sight case and place the shaft of the pickoff centering fixture (SA2312213) in the pivot holes of the support brackets.

   c. Place the plug (part of centering fixture SA2312213)over the shaft.

   d. Slide the stator over the plug to align the stator and housing base.

   e. Dowel the housing base to the lower bearing support.

   f. Remove the centering fixture and the bearing supports from the sight case.

11. With the gyroscope and linkage unit installed in the gyro and gimbal balancing fixture, just prior to reinstallation in the gun sight case, reassemble the sight deflection pickoff and spiral connectors.

12. When reassembling the pickoff, install the rotor and adjust it to approximately null position by lining up the scribe marks on the rotor and the stator.

13. Continue reassembly by reversing the disassembly process.

SUPERELEVATION COMPUTER SECTOR GEAR (FIGURE 3-6).

1. Remove screw (pan hd #4-4x 1/4), washer, and lockwasher from the forward end of superelevation pivot shaft.

2. Loosen the nut (dwg 699228) on the opposite end of the shaft.

3. Remove the shaft with a screw driver. Make a careful inspection of the two bearings housed in the superelevation pivot arm. Replacement of the bearings may necessitate the grinding of another spacer to produce the required 0.002 to 0.004-inch end play.

4. The sector gear can be replaced by filing off the heads of the two rivets securing it to the superelevation pivot arm.

UPPER AND LOWER BEARING SUPPORT BRACKETS (FIGURE 3-5).

1. Remove the sight deflection spiral connectors and pickoff in accordance with instructions in this chapter. Lift the gimbal frame from the gimbal and gyro balancing fixture (SA2311453).

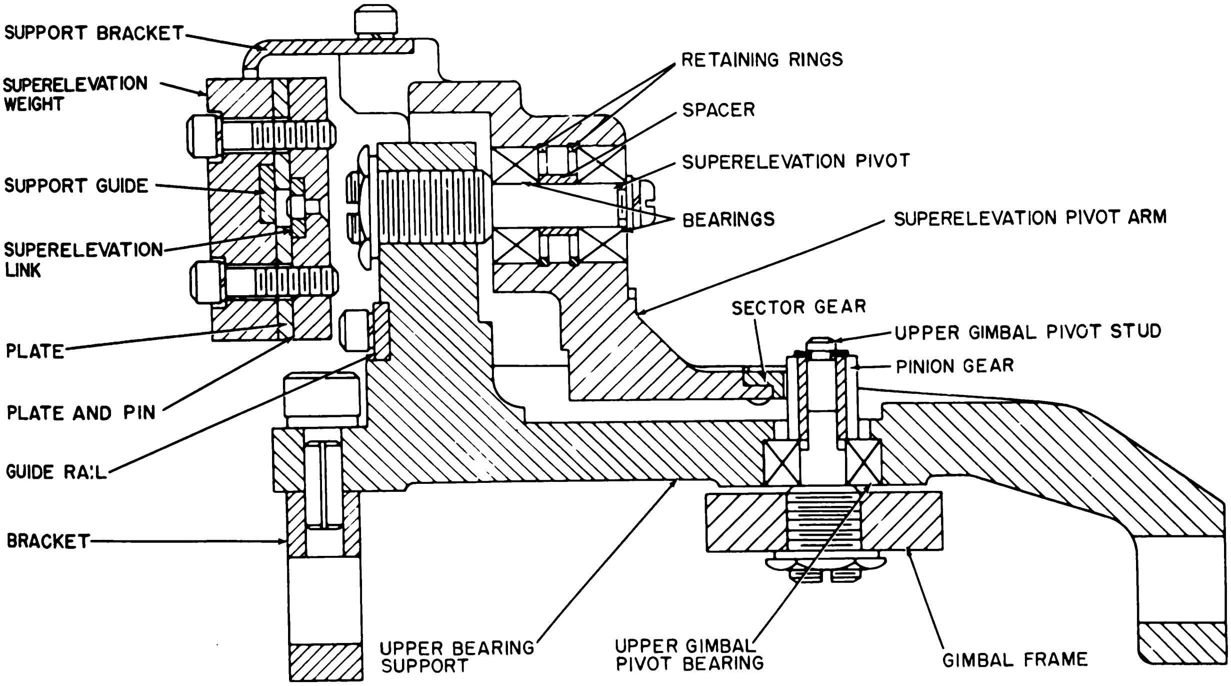


Figure 3-6. Gun Sight Mk 31, Superelevation Computer, Sectioned

2. Slide the lower bearing support bracket and the lower bearing off of the sight deflection pickoff shaft. Do not damage the bearing.

3. Remove the lock ring and pinion gear from the upper gimbal pivot stud, figure 3-6.

4. Pull the upper bearing support and upper bearing from the pivot stud being careful not to damage the bearing. If the stud is worn or pitted, it must be replaced.

   NOTE: The stud should not be replaced until after the removal of the gyroscope from the gimbal frame.

5. Mount the gimbal frame in the spin axis centering fixture (SA2311451) after both the upper and lower brackets have been removed.

SIGHT ANGLE SPIRAL CONNECTORS AND PICKOFF (FIGURE 3-5).

1. With the gimbal frame mounted in the spin axis centering fixture (SA2311451), attach shipping bracket (SA2312211) to the spiral connectors to prevent them from being permanently damaged.

2. Disconnect all electrical leads.

3. Remove self-locking nut (#4-40) from the end of the pickoff shaft.

4. Remove screw (12-Z-1007-1) securing the spiral connector support bracket (dwg. 1413890) to the gyro case and slide the bracket off of the pickoff shaft.

5. Remove the spiral connectors by removing the two screws (12-Z-1007-1) which secure the two spiral connector support brackets (dwgs. 718240 and 1413886) together.

6. Remove the spiral connectors, spacer, and the pickoff rotor from the pickoff shaft.

7. Remove the two screws (12-Z-1007-1) which secure the retaining washers (dwg. 1022206) over the flange of the pickoff stator housing.

8. Remove the stator housing and housing base.

   NOTE: The pickoff shaft can not be removed until the gyroscope unit is disassembled. Care must be taken to avoid damaging the pickoff shaft bearing.

9. If the housing base is to be replaced, the following alignment steps must be followed before the pickoff shaft and gyro are remounted in the gimbal frame.

   a. Place the shaft of the pickoff centering fixture (SA2312213) in the gyro pivot holes of the gimbal frame.

   b. Place the plug (part of centering fixture SA2312213) over the shaft.

c. Slide the stator over the plug to align the stator and housing base.

d. Dowel the housing base to the gimbal frame.

10. Reinstall the gyro in the gimbal. Refer to Chapter 4 for centering procedure.

11. Install the rotor and adjust it to approximate the electrical null position by lining up the scribe marks on the rotor and stator.

12. Continue reassembly by reversing the disassembly procedure.

LINKAGE AND MIRROR UNITS (FIGURE 3-5).

1. Remove self locking nut (#4-40) from both the upper and lower ends of mirror link.

   NOTE: On some of the Gun Sights Mods 1 and 2 the mirror link is fitted with a vibration damping spring. Release the spring and remove the self-locking nuts (#4-40), the spacer and the block assemblies before proceeding to step 2 when disassembling these gun sight linkage and mirror units.

2. Remove the mirror link by pulling it off both shafts simultaneously.

3. Remove the remaining spacer from each shaft and push the shafts out.

4. Loosen the nuts on the mirror pivots and back out the pivot studs until they are clear of the mirror unit.

5. Remove the mirror unit.

   NOTE: The mirror unit may require balancing prior to reinstallation in the gimbal frame. Refer to Chapter 4 for balancing procedure.

6. Remove the gimbal frame from the spin axis centering fixture (SA2311451).

GYROSCOPE UNIT (FIGURES 3-5 AND 3-7).

1. With the gimbal frame removed from the spin axis centering fixture, remove four screws (#4-40x1/4) which secure the sight angle pickoff shaft to the gyroscope case.

2. Remove the locknut from the right-hand gyroscope pivot.

3. Hold the gyroscope in one hand; loosen the pickoff shaft from the gyro case; back off the right-hand pivot; remove the gyroscope.

4. Remove the sight angle pickoff shaft and bearing.

   NOTE: The sight deflection pickoff shaft can be removed by driving out the spring pin which holds it to the lower crossbar of the gimbal frame.

GYROSCOPE DISASSEMBLY (FIGURE 3-7). The gyroscope and eddy current disk are balanced and calibrated as a unit. Proper matching is difficult and extremely precise. Neither the gyro nor the eddy current disk should be disassembled unless absolutely necessary and then only by a gyro expert. The information in this section is given only as an aid.

1. Remove the eddy current disk which is held in place by three screws (soc hd #6-32 x 1/4) located on the back of the hub. These screws are marked with paint and should be replaced exactly as found so that the dynamic balance of the rotor will not be disturbed.

2. Remove stop nut on end of shaft and use a small gear puller to loosen hub. Note relative position of marks on shoulder of shaft and on hub so that they can be reassembled in the same position.

3. Remove six screws from the end shield and carefully tap it loose.

4. Withdraw rotor.

5. Slide stator from case.

   NOTE: The stators of some gyroscope units are secured with a setscrew. The gyroscope stators are not normally removed during overhaul.

6. Replace bearings if they are sticky or rough and will not clear satisfactorily. If the bearings are replaced, the hub distance may not be correct (see note 4 on dwg 689789) and the dynamic balance must be checked.

7. Lubricate the bearings with Beacon 325 grease or equal. Fill the cavity one half full. To lubricate a motor found to be satisfactory without disassembly, remove set screws (#6-32) from holes in the motor housing and add from 1/2 to 2/3 cubic centimeters of lubricant.

8. Make sure the parts in the bearing cavity in the end shield are in the following order on reassembly.

   a. Shims for proper bearing preload.

   b. Spring or springs with finger upward toward the bearing.

   c. Spacer ring.

   d. Washer

   e. **Bearing with face marked THRUST toward the washer.**

COMPENSATING MAGNET COIL AND CORE (FIGURES 3-1 AND 3-2). To replace a magnet coil and core, proceed as follows.

1. Unsolder all electrical leads to the coil.

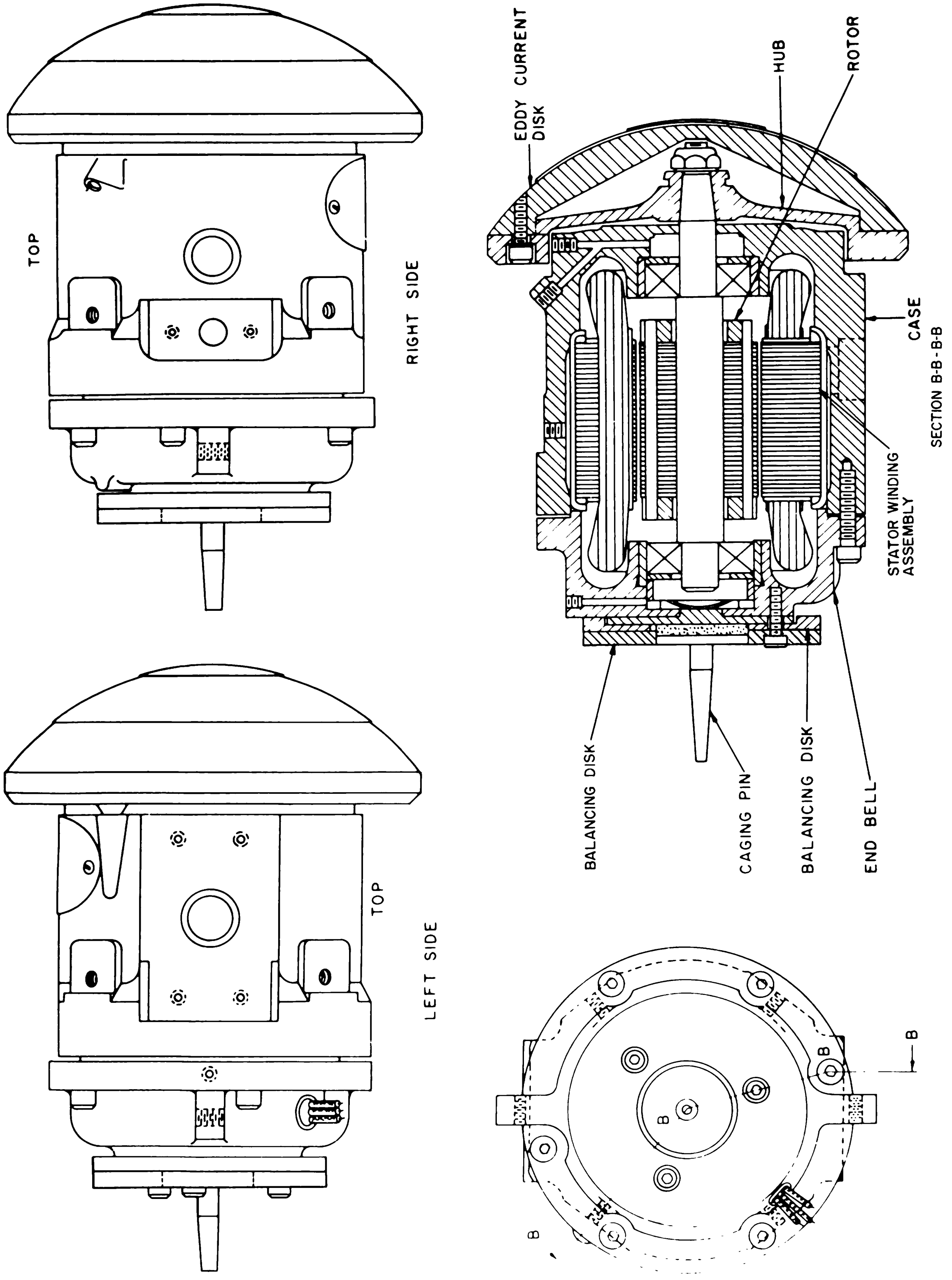


Figure 3-7. Gun Sight Mk 31, Gyroscope Unit Assembly

2. Remove the coils and cores and replace them with new units.

3. Resolder electrical leads to the coil.

TELESCOPE UNIT (FIGURES 3-1 AND 3-2).

1. Unclip the lucite rods and remove from gun sight case.

   NOTE: On gun sight Mods 4 and 5 first remove the light shield. These mods of the gun sight have only one lucite rod.

2. Remove the filter control knob.

3. Remove the three screws (hex soc hd #1/4-20 x 3/4) securing the telescope to the gun sight case. Carefully work the telescope off of its dowel pins and withdraw it from the gun sight case.

   NOTE: Further disassembly of the telescope should only be performed by optical specialists in an air-conditioned room where lens cleaning equipment is available.

ASSEMBLY OF GYROSCOPE AND LINKAGE UNIT (FIGURE 3-5).

1. Replace all worn, damaged components.

2. Balance the mirror in accordance with instructions contained in chapter 4.

3. Reverse the disassembly procedure for assembly. Refer to the notes on dwgs. 689784, 689785, 2094690, and 2094691.

4. After installation, center the gyroscope in the gimbal frame. Refer to chapter 4 for centering procedure.

5. After the pickoffs, mirror and linkage have been installed, perform the static balancing procedure as outlined in chapter 4.

6. After the gyroscope and linkage unit has been installed in the gun sight case, install the superelevation computer. The superelevation computer shaft must have a minimum end play and still remain free. When installing the computer, leave the adjustment screw backed out so that the sector gear will not mesh with the pinion on the upper gimbal pivot stud. The gears are to be meshed during final alignment of the caging device.

CAGING DEVICE. The caging device is removed from the gun sight case rear cover either before or after the cover is removed from the gun sight case. To remove the caging device, proceed with the appropriate instructions after all power to the gun sight has been shut off.

GUN SIGHT MOD 3 (FIGURE 3-8).

1. Remove the eight screws (hex soc hd #10-24 x 1/2) holding the caging device

to the rear cover.

2. Pry the caging device loose from sight case rear cover using two pry slots.

3. Remove set screw securing knob to shaft and take off knob.

4. Using a spanner, take off retaining bushing and remove packing gland and O-ring packing.

5. Remove three screws (#4-40 x 3/8) securing the stationary ring assembly to the caging cover.

6. Push the shaft through the case until the inner ring can be firmly grasped.

7. Pull the ring and linkage system free of cover.

8. Remove three screws (soc hd #4-40 x 1/2) joining inner and outer rings. The outer and inner ring will still be held together by the linkage system. Do not separate members of the linkage system unless component replacement is required.

9. The caging disk should be left doweled to the shaft unless one of the components requires replacement.

10. To replace or clean detent ball and spring, remove detent retaining screw from bottom of caging device.

11. Prior to reassembly, oil parts lightly. Lubricate hydraulic O-ring packing and fill the cavity between the bushing and the case with 12-Z-31200-1. Lubricate the sliding surfaces of the inner ring with MIL-G-15793 before reassembly.

12. To reassemble, reverse the disassembly steps. Be sure that the word CAGED on the knob is on top when the links are in the caged position. If the detent has been removed, stake the retaining screw.

13. Before attaching the device to the rear cover, lubricate the O-ring with 12-Z-31200-1.

GUN SIGHT MODS 1, 2, 4 and 5 (FIGURE 3-9).

1. Remove the servomotor housing cover by removing six screws (12-Z-1007-15).

2. Disconnect electrical power input leads from the servomotor terminal strip.

3. Uncage the gyro manually and remove the caging cover by removing six screws (MS 35461-12). Examine the O-ring fitted in a groove of the caging cover.

4. If planned overhaul does not include the caging disk and linkage system, proceed with disassembly of caging cover servomotor and associated gear shaft at a bench.

5. After all the leads to the terminal strip have been disconnected, remove the terminal bracket and the attached terminal strip by

removing two nuts (#6-32). After the bracket has been removed the nuts should be again fastened to the screws (MS35338-79) from which they were removed. If necessary the terminal strip can be removed from the bracket by removing four screws (MS35233-30).

6. To loosen the coupling and pinion from the servo motor shaft loosen or remove two screws (12-Z-1008-3). Slide the coupling up off the servo motor shaft and slide the servo motor and attached plate out of the housing.

   NOTE: The servo motor housing cover when mounted holds the plate in place.

7. Remove the shaft and coupling by loosening or removing the screw (MS35461-1) in the caging lever, pulling the lever from the shaft, and sliding the shaft down through the gland and housing.

8. The coupling, pinion, and shaft should be left pinned together, unless replacement of one of the parts is necessary.

9. If the plunger or latch spring in the caging lever is defective remove the pivot pin and latch.

10. The stop lugs need not be removed from the housing unless they have been damaged.

11. To reassemble reverse the disassembly steps.

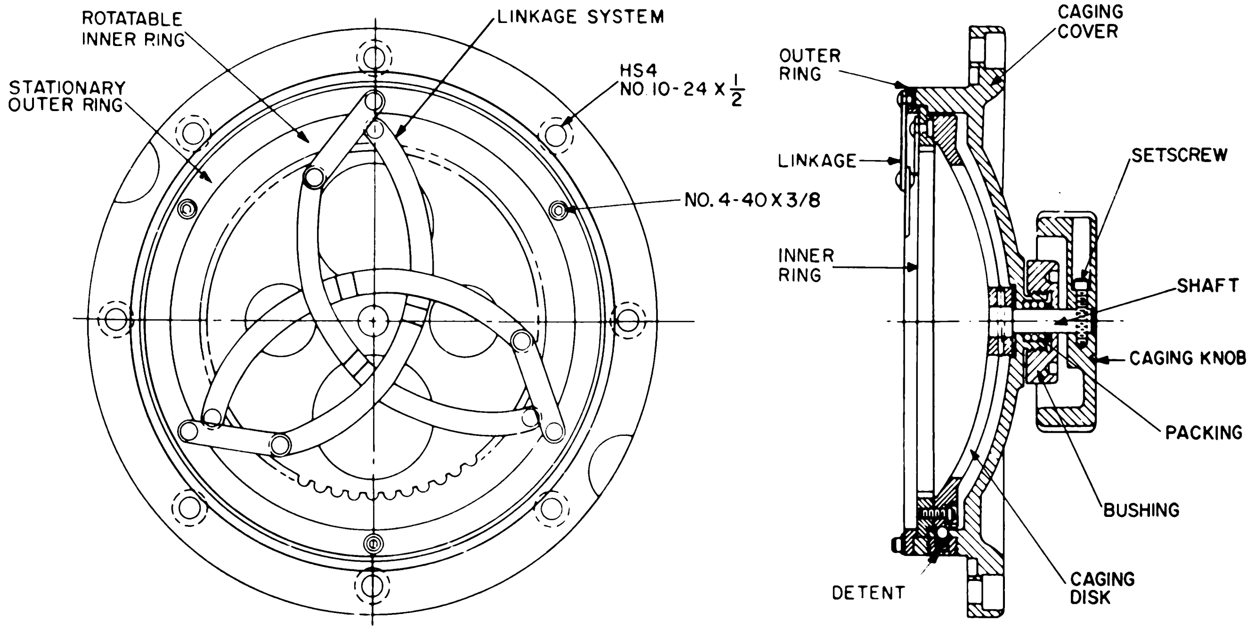


Figure 3-8. Gun Sight Mk 31 Mod 3, Component Arrangement of Caging Device

NOTE: If the caging support is to be disassembled, reassembly of the caging cover should follow the completion of steps 16 through 24.

12. Lubricate the pinion and shaft lightly with instrument grease (MIL-G-15793) before reassembly.

13. When placing the servo motor back in the housing make certain the coupling drops freely down on the servo motor shaft. No binding or misalignment can be tolerated.

14. To align the pinion and gear vertically fasten the caging cover to the assembled caging support and move the coupling up or down on the servo motor shaft until the proper mesh is obtained. Tighten the two screws (12-Z-1007-3) which secure the coupling to the servo motor shaft.

NOTE: The screw holes in the caging support and caging cover will align only when the hole for the servo motor leads in the caging support is opposite the hole for the servo motor leads in the caging cover.

15. With the caging support and caging cover still fastened together and the caging spring holding the linkage in the closed position, adjust the caging lever until the latch is directly behind the stop lug on the caged side of the housing, and tighten the screw (MS35461-1) which secures the lever to the shaft.

16. Remove the caging support assembly from the main cover by removing six screws (MS35461-26).

17. Unhook the caging spring and remove the spring anchor by removing screw (MS35233-30).

18. Remove the gear and spring by removing screw (MS35233-17) and pulling the gear from the shaft.

19. Remove the three screws (MS-35337-78) which secure the retainer and detent ring to the caging support, but do not try to remove the retainer.

20. Push on the gear end of the shaft and with the caging linkage open grasp the caging disk and pull it free from the caging support. The retainer and detent ring will remain attached to the caging disk.

21. The retainer and detent ring can be removed from the caging disk by removing three screws (MS35337-78). After the removal of the screws the retainer and detent ring will still be held together by the caging links. Since these links are riveted to the retainer, the detent ring, and each other it is not advisable to separate them unless replacement of a part is necessary.

22. The caging disk should be left doweled to the shaft unless either piece needs replacement.

23. Reverse the disassembly procedure for reassembly.

24. Lubricate the gear and shaft lightly with instrument grease (MIL-G-15793) before reassembly.

OVERHAUL AND REPAIR OF AMPLIFIER MK 121. The range servo unit of the amplifier should be given a complete overhaul about every 20 months or after 1000 hours of operation. The remaining units of the amplifier do not require periodic overhaul. The overhaul will normally consist of a complete breakdown and inspection of the equipment. If repairs are required between overhaul periods, appropriate portions of the following instructions may be used.

RANGE SERVO UNIT (FIGURE 3-10)

1. Remove the four corner bolts (hex hd 1/4 - 20 x 3) from the amplifier cover.

2. Unplug the unit from amplifier chassis.

3. Remove the remaining two bolts (hex hd 1/4 - 20 x 2 - 1/2), invert the unit, and remove the two screws (flat hd #10 - 24 x 5/8) holding the cover to the lower plate.

4. Remove the cover from the unit.

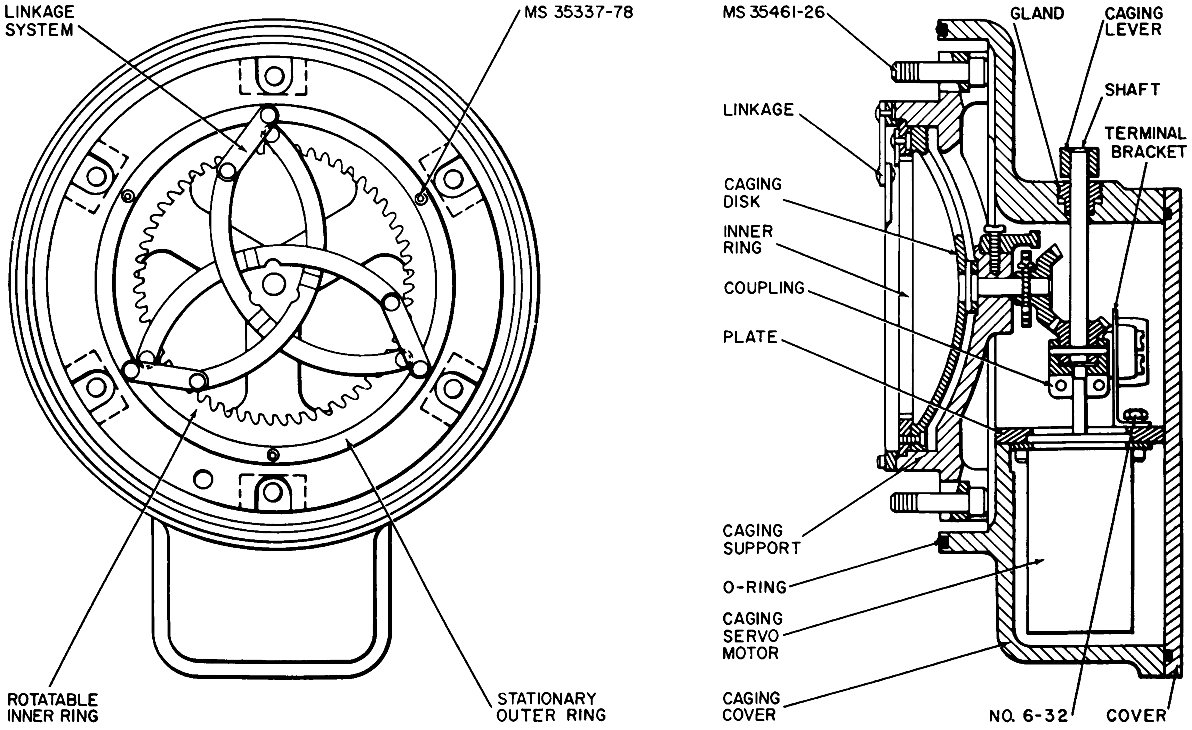


Figure 3-9. Gun Sight Mk 31 Mods 1, 2, 4, and 5, Component Arrangement of Caging Device

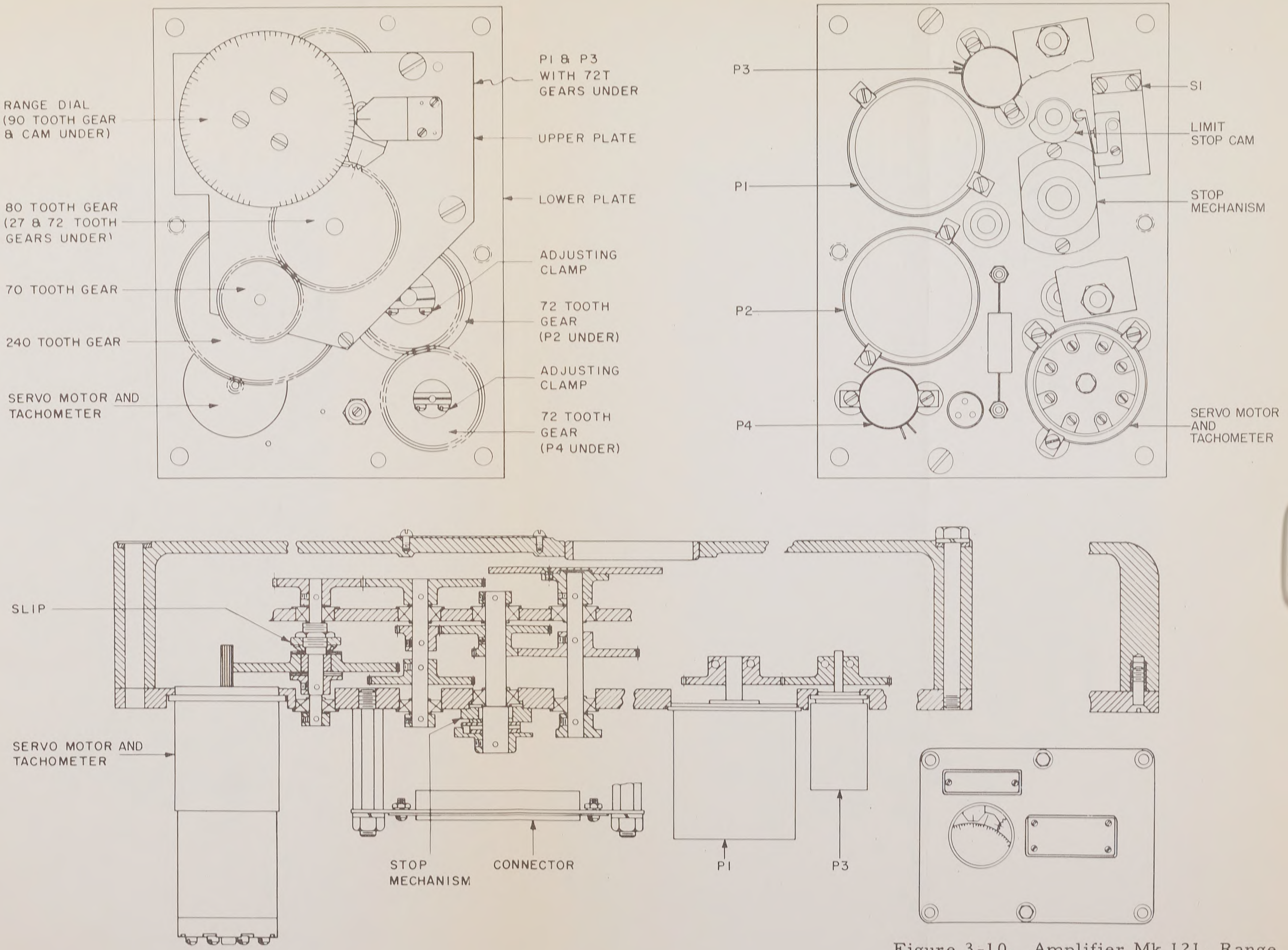


Figure 3-10. Amplifier Mk 121, Range Servo Unit, Component Arrangement

5. Remove the two nuts (hex hd 1/2 - 30) holding the connector to the posts.

6. Remove the connector.

7. Remove the motor-tachometer and all four potentiometers.

8. Drive the pins from the collars on shafts 2 and 3, from the collar and gear on the stop mechanism on shaft 4, and from the cam on shaft 5.

9. Remove the collars, the stop mechanism, and the cam.

10. Remove the lower plate.

11. Drive the pins from the 70-tooth gear on shaft 2, the 80-tooth gear on shaft 4, the gear and dial assembly on shaft 5, and the collar on shaft 4.

12. Remove the shafts from the upper plate and all bearings from both plates.

13. Remove remaining gears as necessary.

14. Inspect all parts for wear or deformation. Repair, lubricate, or replace as necessary.

15. Lubricate all ball bearings as necessary.

16. Reverse the disassembly procedure for reassembly.

17. Be sure to place the cam in the correct position.

18. Make sure that S1 is set to trip at 490 and 7900 yards.

19. Make sure that the stop mechanism operates at 450 and 8900 yards. The stop **mechanism should operate at 450 and 8850 yards for the Mod 1 with serial numbers 75 through 82.**

20. Install all potentiometers with clamps loosened.

21. Set dial at 450 yards. Install the 80-tooth gear on shaft 3 with "0" scribe mark on pointer.

22. Engage all potentiometers after first rotating all potentiometer shafts from their low limit positions. Rotate P1 and P2 1/6 turn clockwise and rotate P3 and P4 1/6 turn counterclockwise. Zero all potentiometers in accordance with instructions contained in chapter 4.

23. Further disassembly of the amplifier is unnecessary unless the unit fails to pass the tests described in chapter 4.

Chapter 4

TEST AND ALIGNMENT PROCEDURES

This chapter contains those procedures necessary to complete the reassembly of the gun sight and to test the gun sight and amplifier before they are returned to service.

A list of test equipment and special fixtures required is contained in Appendix A. A tabulation of drawings and lists of drawings, in Appendix B; and a compilation of pertinent unit schematics and wiring diagrams (Bureau of Naval Weapons Dwgs.) in Appendix C.

CENTERING THE GIMBAL FRAME

1. Install the gimbal frame in the sight case with the bearing and spacer only in the lower support bracket.

2. Place the plug of the gimbal centering fixture (SA2312212) in the range magnet mount.

3. Place the cross piece of the centering fixture through the large hole (right gyro pivot) in the side of the gimbal frame, through the hole in the plug, and through the small hole (left gyro pivot) in the gimbal frame. This fixes the vertical position of the gimbal frame and the spin axis of the gyro with respect to the sight case.

4. With a dial indicator measure the clearance between the bottom of the gimbal frame and the top of the bearing.

5. Use shims (Dwg 688991-24, -124, or -224) as required to obtain the proper spacing. About 0.017 inch is usually required when both the gimbal frame and the bracket are new.

MIRROR UNIT BALANCE

1. Place the mirror unit in the balancing fixture (SA2311452), figure 5-1.

2. Place a drilled weight on the connecting link pivot shaft. Drilled weight should be equal to the weight of the below items plus one half the weight of link BuOrd Dwg. 706493 and Spring BuOrd Dwg. 2076592.

Spacer	2076590	Qty. 1
Spacer	2076591	Qty. 1
Spacer	706798	Qty. 1
Nut	12-Z-2007-245	Qty. 1

NOTE: The weight of shaft BuOrd 706518 is not included above since it is assumed this will be installed in the mirror arm to carry the drilled weight.

3. Turn the counterweights until

the assembly will stay in any position. Stake the counterweights.

CENTERING OF THE GYRO SPIN AXIS IN THE GIMBAL

1. Before the pickoff stator, rotor, connectors, and mirror are attached, place the gyro and gimbal assembly in the spin axis centering fixture (SA 2311451), figure 4-2, with the disk toward the dial indicator.

2. Place a block of sponge rubber between the gyro and the top of the gimbal to keep the gyro axis approximately at right angles to the gimbal.

3. Adjust the gyro pivot bearings so that the gyro appears to be centered in the gimbal. Leave definite end play, but always have the locknut tight when taking readings.

4. Place a small sponge rubber wedge between the right side of the gyro and the gimbal so that the forward end of the motor will be pressed toward the left side of the gimbal.

5. Make a small spot on the disk about 1/8 inch from the edge.

6. Swing the gimbal clockwise and rotate the disk to bring the dot under the tip of the indicator. Set the indicator to read zero.

7. Turn the gimbal counterclockwise and rotate the disk 180 degrees to bring the spot under the indicator. Note the indicator reading.

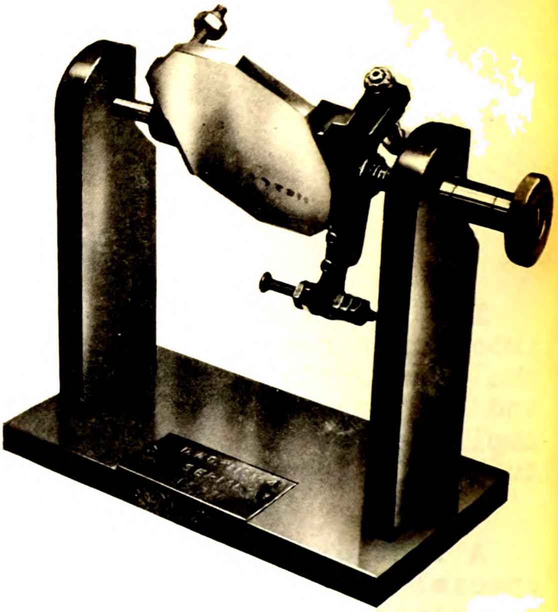


Figure 4-1. Gun Sight Mk 31, Mirror Mounted in Figure Balancing Fixture (SA2311542)

8. If the reading of step 6 is larger than that of step 7, the pivot on the left side is out too far. Remove the gyro and add shims to decrease the difference between readings by one half. Tighten the locknut and repeat steps 6 and 7 until the reading in step 6 is less than that in step 7 by 0.0005 inch to 0.001 inch.

9. Remove the rubber wedge and block. Place the dial indicator so that it measures the end play between the gyro and the gimbal. Press the gyro against each pivot in turn. Adjust the right pivot until there is between 0.0015 inch and 0.002 inch end play.

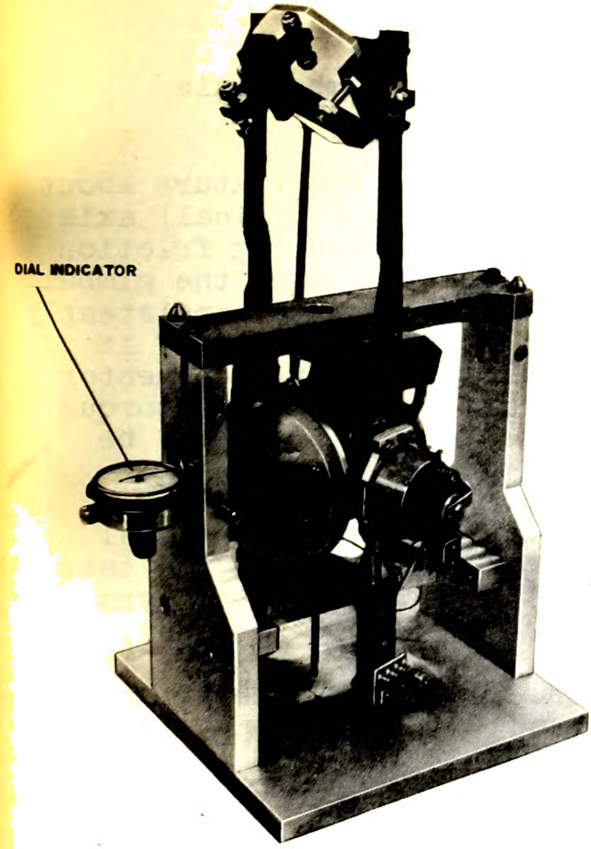


Figure 4-2. Gun Sight Mk 31, Gyro Unit Mounted in Spin Axis Centering Fixture (SA2311451)

10. Replace the rubber block, but not the wedge, and repeat steps 6 and 7. The difference in reading should be less than 0.001 inch.

END PLAY SETTINGS OF MIRROR FRAME PIVOTS

Adjust the end play of the mirror frame unit pivot bearings until it is between 0.0005 inch and 0.001 inch. To check this, press the mirror frame lightly against one bearing and then the other. The difference between the two indicator readings is the end play.

STATIC BALANCE OF GYRO UNIT

1. When completely assembled place the gyro unit in the static balancing fixture (SA 2311453), figure 4-3.

2. Set the fixture so that gimbal pivot axis is vertical and gyro spin axis is horizontal, figure 4-3.

3. Adjust the balance stud and nut on the top (or bottom) of the gyro until gyro is balanced. The stud can be screwed to any position in its locating hole.

4. Set the fixture so that the gimbal axis and gyro pivot axis are both horizontal and the gyro spin axis is vertical, figure 4-4.

5. Hold the gimbal steady with fingers and note which side of the gyro is heavy.

6. Release gimbal and note which side of the gimbal is heavy. The balance stud and nuts on the caging pin end of the gyro can be placed on either lug (top or bottom) to help balance the gimbal. Once these positions are chosen, then adjust the stud and nuts to balance the gyro (steps 2 and 3).

7. Set the fixture so the gimbal axis is horizontal and gyro pivot axis is vertical, figure 4-5. Note which side of the gimbal is heavy.

8. Adjust the balance nut which is perpendicular to the plane of the gimbal until the unit is balanced. If

necessary, use larger or smaller nuts or a combination of the two. The stud may enter from either side of the gimbal. This is approximate balance only. It must be refined after the gimbal is installed in the sight case and the traverse pickoff and superelevation computer have been added.

9. With the fixture in the same position as in step 4, note which side of the gimbal is heavy.

10. Adjust the gimbal balance nut which is in the plane of the gimbal until unit is balanced. If necessary, use larger or smaller nuts or a combination of the two. This is an approximate balance and it must be refined after the gimbal is installed in the sight case and the traverse pickoff and superelevation computer are added. In this position, the gimbal will appear slightly top heavy since the end play in the gyro pivot allows the gyro to slide to the low side.

    NOTE: In all the preceding adjustments, it is desirable not to leave the adjusting nuts at an extreme position since further refinement will be necessary.

11. Check the gyro and gimbal spiral connectors to make sure that they do not affect the gyro balance by exerting torque on the unit. Check the gimbal connectors with the gimbal axis vertical.

12. Oscillate the fixture about the gimbal (vertical) axis to reduce bearing friction and note whether the gimbal tends to rotate consistently in one direction. If it does, the spiral connector leads are causing a torque and they will have to be adjusted.

13. To check the gyro spiral connectors, place the test fixture so that the gyro pivot axis is vertical; oscillate the fixture about this axis and see if the gyro rotates.

SUPERELEVATION COMPUTER END PLAY

1. Adjust the end play in the superelevation idler shaft until it is very nearly zero. There should be no increase in bearing friction due to end thrust when the screw is tightened.

2. After the end play has been adjusted, install the face gear unit in the sight and leave the screw adjustment backed out so that the face does not mesh with the pinion gear on the gimbal axis. Final adjustment will be made later.

INSTALLATION OF GYRO AND LINKAGE UNIT

1. With the shipping bracket (SA 2312211) attached, carefully place the gyroscope and linkage unit in the sight case. Slide the upper and lower bearing

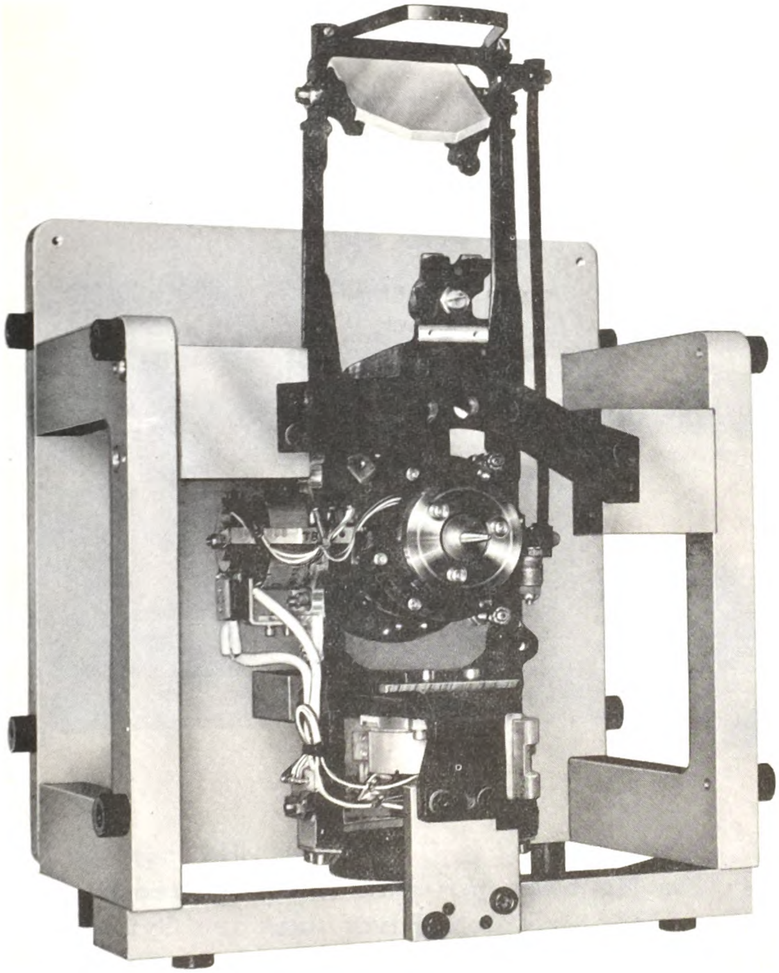


Figure 4-3. Gun Sight Mk 31, Gyro Unit Mounted in Static Balance Fixture (SA2311453), Gimbal Pivot Axis Vertical and Gyro Spin Axis Horizontal

supports onto their dowels and tighten ten screws (hex soc hd #10-24 x 5/8) that secure the supports to the sight case.

2. Remove shipping bracket and immediately attach the nutation damper.

3. Recheck the gimbal balance and refine as necessary.

4. Refer to chapter 3 for

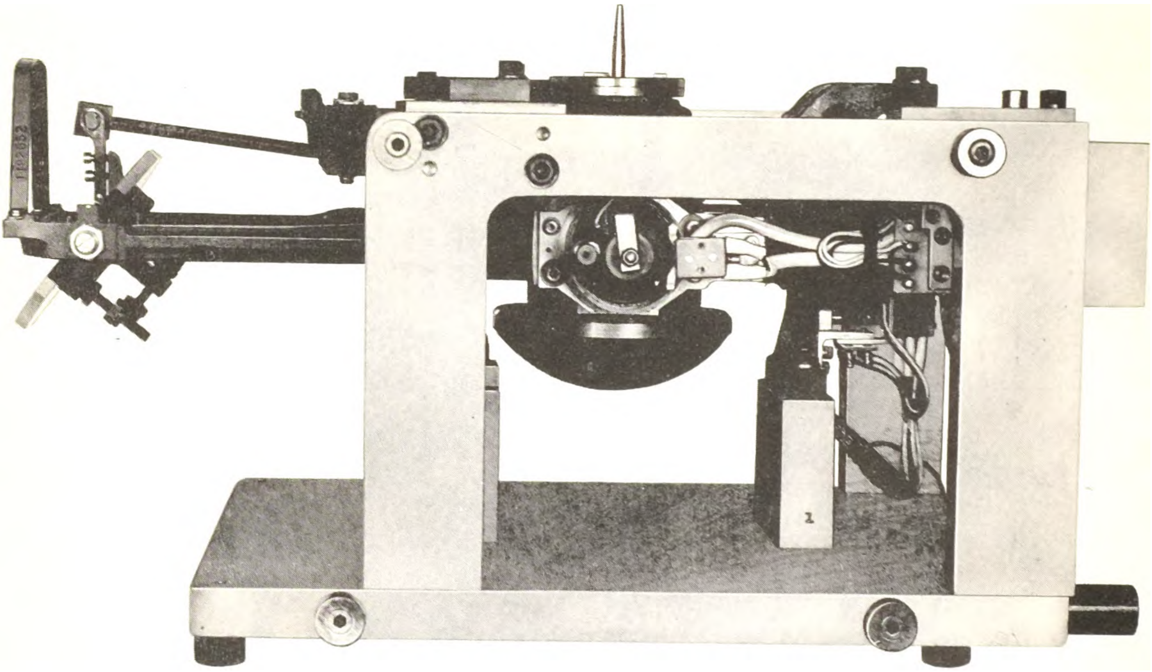


Figure 4-4. Gun Sight Mk 31, Gyro Unit Mounted in Static Balance Fixture (SA2311453);Gimbal Pivot Axis and Gyro Pivot Axis Horizontal, and Gyro Spin Axis Vertical

additional assembly of the unit.

5. Do not install the sight case front window. It will be installed upon completion of tests.

ELECTRICAL CONNECTION AND CALIBRATION UNIT.

1. Using a four place resistance bridge, check the continuity of wiring and resistance as follows:

J1-A	J6-E	Continuity
J1-B	J6-F	Continuity
J1-C	J6-G	Continuity
J1-D	J7-J	Continuity
J1-F	J7-K	Continuity
J1-J	J7-L	Continuity
J1-J	J3-K	Continuity
J2-A	J7-P	Continuity
J2-B	J7-U	Continuity
J2-C	J7-D	Continuity
J2-D	J7-N	Continuity
J2-E	J7-F	Continuity
J2-F	J7-G	Continuity
J2-H	J7-H	Continuity
J2-K	J7-R	Continuity

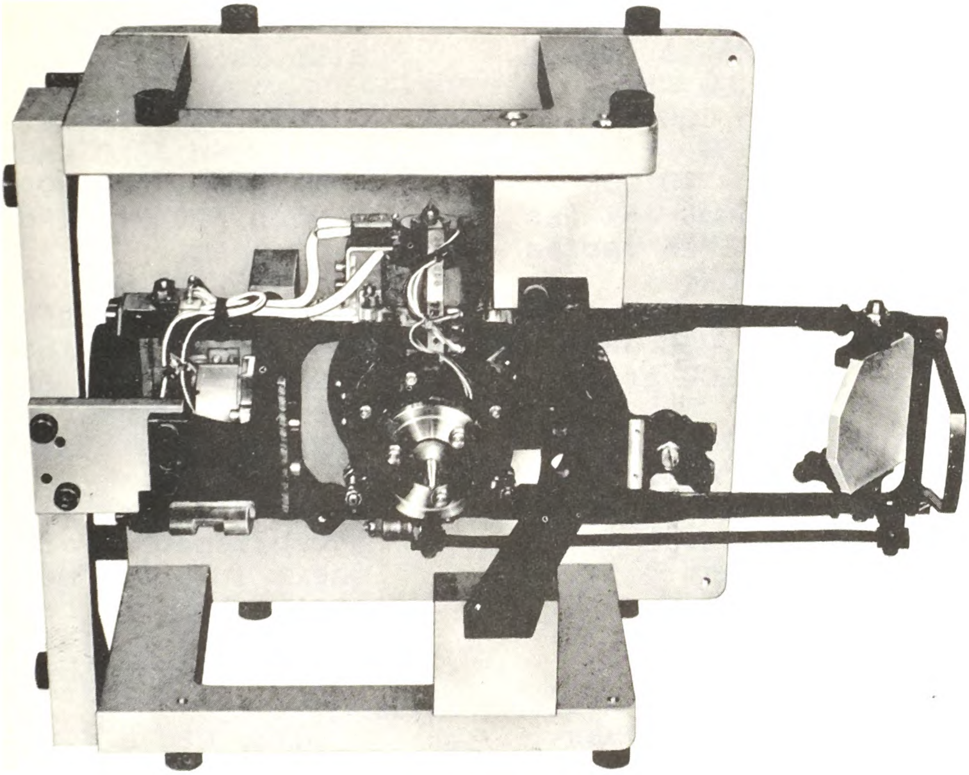


Figure 4-5. Gun Sight Mk 31, Gyro Unit Mounted in Static Balance Fixture (SA2311453), Gimbal Axis Horizontal and Gyro Pivot Axis Vertical

J3-B	J6-V	Continuity
J3-C	J6-R	Continuity
J3-D	J6-S	Continuity
J3-E	J7-C	Continuity
J3-F	J7-M	Continuity
J3-H	J7-E	Continuity
J3-J	J7-B	Continuity
J4-A	J6-A	Continuity
J4-B	J6-N	Continuity
J4-C	J6-C	Continuity
J4-D	J6-D	Continuity
J4-E	J6-B	Continuity
J4-F	J6-P	Continuity
J4-F	J4-H (Shorted)	*Discontinuity exists before installation of R11.
J4-H	J1-K (Shorted)	Discontinuity with short removed, Mod 3
J4-J	J6-T	Continuity
J4-K	J6-U	Discontinuity at room temperature
J5-C	J7-W	Continuity
J5-D	J7-X	Continuity
J5-E	J7-Y	Continuity
J5-F	J7-Z	Continuity
J5-H	J6-K	Continuity

*The value of trim resistor R11 is to be determined during test procedures.

J1-E J7-J	25,000 ohms ±5%
J1-E J7-T	0 - 10,000 ohms ± 5% (as R6 is varied CCW)
J1-H J7-K	25,000 ohms ± 5%
J1-H J7-A	0 - 10,000 ohms ±5% (as R1 is varied CCW)
J6-L J6-M	206 ohms ±1%
J6-L J6-H	47,900 ohms ± 10% at 20°

2. Measure the resistance of all wiring to ground using a 500-volt DC insulation tester. This resistance should be at least 3 megohms.

RANGE RATE SERVO UNIT

1. Using a 500-volt DC insulation tester, measure the insulation resistance of all wiring with respect to the chassis. This resistance should be at least 3 megohms.

2. Rotate the range rate dial in both directions and check the mechanical limits of the stop mechanism. The negative stop should be at -650 knots and the positive at + 400 knots.

3. Rotate the dial to the positive mechanical limit stop. The positive limit switch (S1) should open at the maximum positive dial reading and before the mechanical stop is reached.

4. Rotate the dial to the negative limit stop. The negative limit switch (S2) should open at the maximum negative dial reading and before the mechanical stop is reached.

   NOTE: The resistance between J3-C and J3-D is 210 ohms ± 10 percent when either S1 or S2 is open.

5. Set the gear train at 0 knots as determined by the dial and scribe mark on the vernier gear. Lock the gear train at this position.

6. Make sure that all the potentiometers are set with their internal mechanical limits beyond the servo mechanical limits to prevent damage to the potentiometers.

   NOTE: Use a five-place resistance bridge for adjusting potentiometers.

7. Adjust parallax potentiometer (P4) to measure 59.4 ohms ± 1 percent. P4 is adjusted to the "null position" when installed and measured at terminals J2A and J2C.

8. To adjust the fuze potentiometer (P3) on Mods 1, 2, 4 and 5 (not used on Mod 3):

   a. Measure and record the total resistance between terminals 1 and 3 of P3.

   b. With the range rate set at -300 knots, disengage the rotor gear and adjust the resistance between 2 and 4 (with wiper number 2 between 1 and 3) to equal the resistance between 1 and 3, times 0.2553.

c. Check the location of the wiper between 2 and 4 by getting a higher reading between 1 and 4 than between 1 and 2.

9. Adjust the response potentiometer (P1) to obtain a null between J2-F and J2-K. The null should be 3.5 ohms or less between terminals 2 and 4 of P1.

10. To adjust the magnet current potentiometer (P2) on Mods 1, 3, and 4:

    a. Set the vernier gear by counting 50.5 teeth clockwise from the zero reference scribe mark and set this point to the zero index. Two teeth short of the 180-degree scribe mark should give the same setting. Both should correspond to -260 knots on the range rate dial.

    b. Loosen the shaft clamp and, using a string belt, rotate the shaft until 200 ohms ± 5 percent is measured between J3-H and J3-J of the range rate servo. Terminals 1 and 2 are shorted, therefore resistance can be measured across terminals 1 and 3 or 2 and 3.

    c. Tighten the clamp and make sure that there is a constant 200 ohms ± 5 percent for range rates above -260 knots.

11. To adjust the magnet current potentiometer (P2) on Mods 2 and 5:

    a. Set the vernier gear by counting 62.5 teeth clockwise from the zero reference scribe mark and set this point to the zero index. Ten teeth past the 180-degree scribe mark should give the same setting. Both should correspond to -320 knots on the range rate dial.

    b. Loosen the shaft clamp and, using a string belt, rotate the shaft until 400 ohms ± 5 percent is measured between J3-H and J3-J of the range rate servo.

    c. Tighten the clamp and make sure that there is a constant 400 ohms ± 5 percent for range rates above -320 knots.

12. Rotate the gearing to the lower mechanical stop.

13. Mount a 1/4-inch pulley on the shaft of the servomotor.

14. Using a spring scale, make sure that the clutch slips at 8 ± 1 ounces.

15. Rotate the gearing to the upper mechanical stop and repeat steps 13 and 14.

16. Mount the pulley wheel on the motor shaft.

17. Using a spring scale, measure the starting torque of the gearing in both the clockwise and counterclockwise directions.

18. Repeat step 17 to obtain a total of three readings in each direction.

19. Average the readings to obtain the starting torque. This should not exceed 1/4 ounce-inches.

20. Measure the running torque of the gearing in the clockwise and counterclockwise directions for three different portions of the range rate dial. The running torque should not exceed 1/8 ounce-inches.

INSPECTION

After the units have been replaced in the sight case, before proceeding further make sure that:

1. There are no obvious errors in assembly.

2. There is no interference due to wiring, balance nuts, etc., and that there is no interference in the air gap.

3. The spiral connectors are not rubbing, buckling, or otherwise faulty, and that the superelevation computer is disengaged.

PICKOFF POLARITY AND NULL POSITION

1. Place the sight on the turntable (SA 2312192), figure 4-6, or turntable and pedestal adapter (SA 2312192).

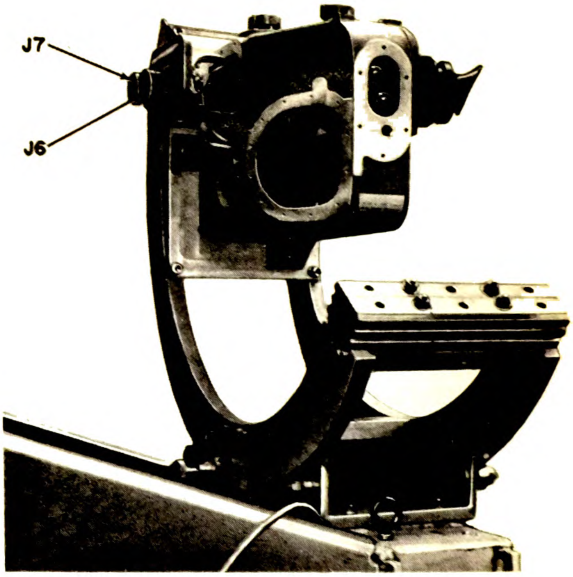


Figure 4-6. Gun Sight Mk 31, Mounted on Turntable (SA2312192)

2. Remove the electrical connection and calibration unit and reinstall it with extensions.

3. Connect the cables P6 and P7 of the gyro start and magnet current panel box to J6 and J7 on the gun sight.

4. Remove the plug from J1 of the connection and calibration unit and place jumper J1 between the plug and the jack.

5. Jumper J1-C to J1-E.

6. With power applied to the gun sight, move the caging pin downward. This should give an increasing reading from 115 volts on a vacuum-

tube voltmeter connected to J1-A and J1-D. If the readings are in the wrong direction, rotate the rotor of P01 180 degrees and repeat the test.

7. Remove the jumper and connect the vacuum-tube voltmeter to J1-E and J1-D (ground).

8. Move the caging pin up and down through the center and check that a minimum null of 300 millivolts can be obtained.

9. Jumper J1-C to J1-F.

10. With power applied to the gun sight, move the caging pin to the right. This should give an increasing reading on a vacuum-tube voltmeter connected to J1-A and J1-H. If the readings are in the wrong direction, rotate the rotor of P02 180 degrees.

11. Remove the jumper and connect the vacuum-tube voltmeter to J1-H and J1-F (ground).

12. Move the caging pin to the right and left through center and check that a minimum null of 300 millivolts can be obtained.

TURNTABLE TESTS

1. On gun sight mods 1, 2 and 3, install the eyepiece mounting bracket after test eyepiece has been attached to the bracket and secure the gyro retaining ring (SA 2312203), figure 4-7 to the sight case. The test eyepiece is not used on gun sight mods 4 and 5.

2. Install the collimating lens (SA 2312206) on the objective lens.

3. Jumper the terminals of the cam magnet to remove compensation for optical error.

4. Start the gyro and let it run for at least one-half hour.

5. Refine the gyro balance.

6. With the sight in an upright position, figure 4-7, with the gyro running uncaged, and with approximately 60 ma flowing in the magnet circuit, determine the test zero traverse reading on the scale.

7. Open the magnet circuit and wait 30 seconds.

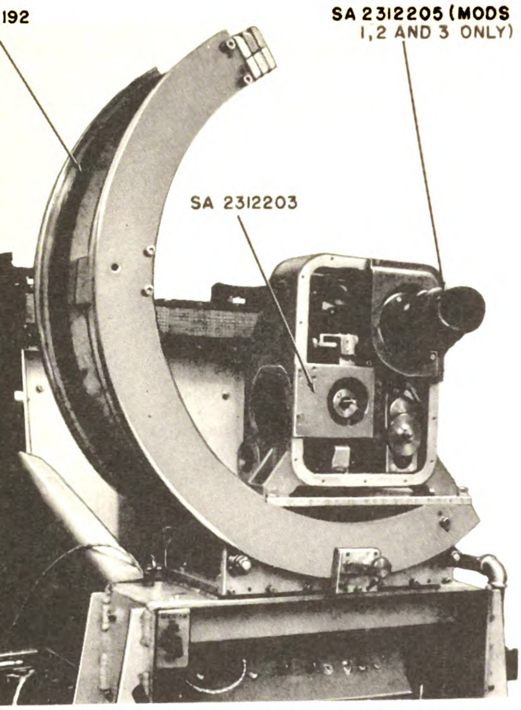
8. Read the change in the traverse reading.

9. Adjust the balance nut on the gyro which is parallel to the spin axis of the gyro until the horizontal wander is less than 3 mils for the 30-second period.

10. Test the balance stud with finger torque to determine in which direction the balance correction must be made.

11. Rotate the sight 90 degrees, figure 4-6, and repeat the tests.

12. Balance correction must be



igure 4-7. Gun Sight Mk 31, Mounted on Turntable in Upright Position

made with the balance nut on the gimbal which is parallel to the spin axis. Wander must be less than 3 mils for a 30-second period.

NOTE: If the weight of the nuts must be changed, the gyro unit must be rebalanced without the gyro running as in the static balance fixture.

Remove jumper from terminals of cam magnet.

CTION TEST

With the sight in the upright position, with the gyro running and with no magnet current, rotate SA 2312192 at 0.25 degrees/second, SA 2312210 at 3/8 degrees/second.

2. Measure the drift up or down during a 30-second period and note the reading.

3. Reverse the rotation of the turntable and repeat the test. The friction is one-half the algebraic difference between the two readings. The friction should not exceed 7.5 mils in a 30-second period.

4. Repeat the tests for the 90-degree position. If the sight fails the tests, check the end play of the bearings and the alignment of the bearings. If these are correct, replace the bearings.

AIR GAP CENTERING AND MAGNET CENTERING

1. Jumper R11.

2. With the sight in the upright position, with the gyro running, and with current flowing in the magnet circuit as follows, rotate the turntable at the speed indicated.

Mods	SA 2312192 (4 deg/sec)	SA 2312210 (6 deg/sec)
1 & 4	36.07 ma	42.81 ma
2 & 5	33.67 ma	40.95 ma
3	36.07 ma	43.88 ma

3. Adjust the magnet in or out in its case until the average of the clockwise and counterclockwise traverse reading is 199 mils.

4. As the correct air gap is

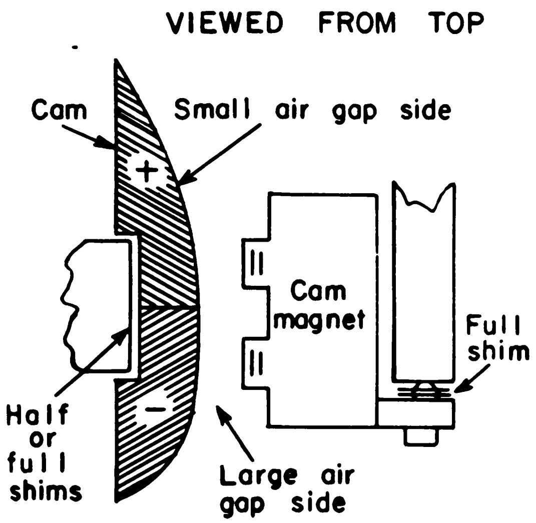


Figure 4-8. Amplifier Mk 121, Relationship of Compensating Cam to Magnet

approached, loosen the screws holding the magnet centering mechanism and adjust the magnet to make the clockwise and the counterclockwise readings equal to within 2 mils. If the clockwise reading is larger than the counterclockwise reading, move the magnet up until the reticle image moves up the exact amount of the difference in the readings. If the clockwise reading is smaller than the counterclockwise reading, move the magnet down until the reticle image moves down the exact amount of the difference in the readings.

5. Recheck the clockwise and counterclockwise readings until they are equal to within 2 mils.
6. Rotate the sight 90 degrees and repeat the tests.
7. Recheck in the upright position.

NUTATION DAMPER

With 75 ma flowing in the magnet circuit and the sight in the upright position, strum the caging pin with the finger to produce a deflection of 100 mils. The resulting nutations should decay within 2 seconds.

COMPENSATING CAM AND MAGNET ALIGNMENT

The cam end marked (+), figure 4-8, affects the readings in the positive traverse direction while the end marked (-) affects traverse readings in the negative direction. The function of the alignment procedure is to increase or decrease the coupling between the magnet and the end of the cam which needs correction.

1. Apply power to the gyro.
2. Set range magnet current at:

Mods	SA 2312192	SA 2312210
1 & 4	29.50 ma	29.72 ma
2 & 5	27.50 ma	27.72 ma
3	29.50 ma	29.72 ma

3. Rotate the turntable by hand, taking elevation readings at 50-mil steps counterclockwise and clockwise.
4. Record the readings and plot the curves as in figure 4-9. Any part of the curve below the base line indicates over correction by the associated cam end; any part above indicates too small

a correction.

5. Use the curves, figure 4-9, and alignment guide, figure 4-10, as a rule of thumb for cam and magnet alignment. Means for changing the coupling are full or half shims (dwgs 1022254-1 and -2) under the cam to change the air gap. Shimming between the magnet bracket and the mounting strut is used to change the magnet centering which will increase coupling at one end and decrease it at the other, depending upon whether shims are added or removed. If an excess of shims are added or removed, recheck the gimbal balance.

CALIBRATION SCALE

1. With the gyro running, set the magnet current at approximately 60 ma.
2. Adjust the traverse scale so that the zero (middle) dot lines up with the index marker at the zero position of the gimbal.
3. Read the zero position on the test scale.
4. Turn off the magnet current
5. Precess the gyro right and left by hand until the second dot on each side lines up with the index marker.
6. Read the test scale for each position.
7. The second dot should be at 152 mils ± 2 percent.
8. Establish zero in train and elevation.

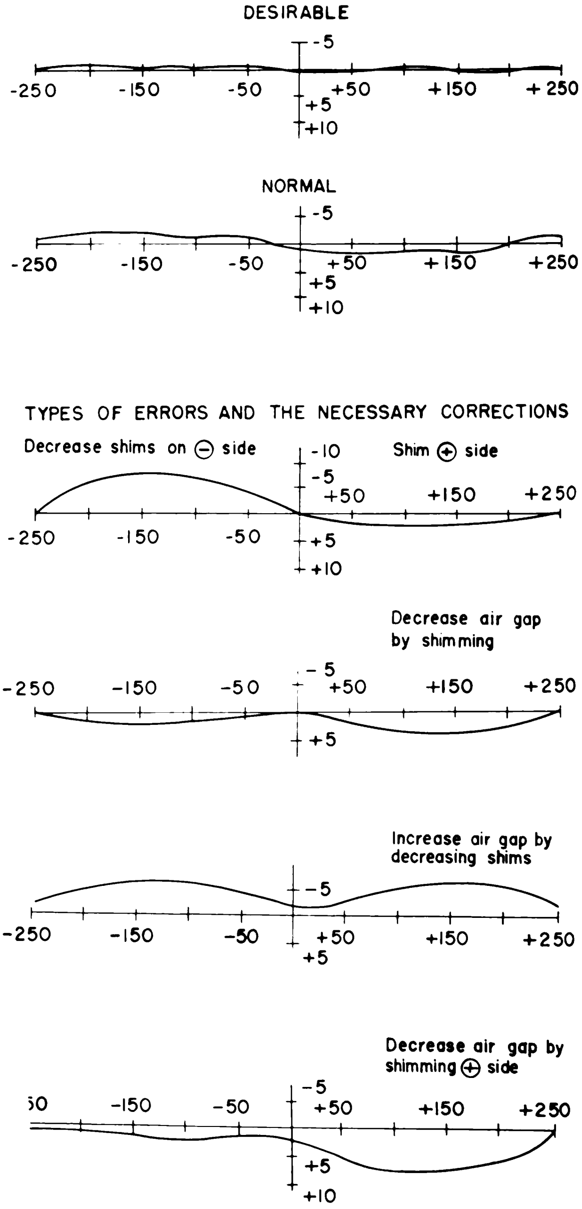


Figure 4-9. Amplifier Mk 121, Curves for Adjusting Magnet and Cam

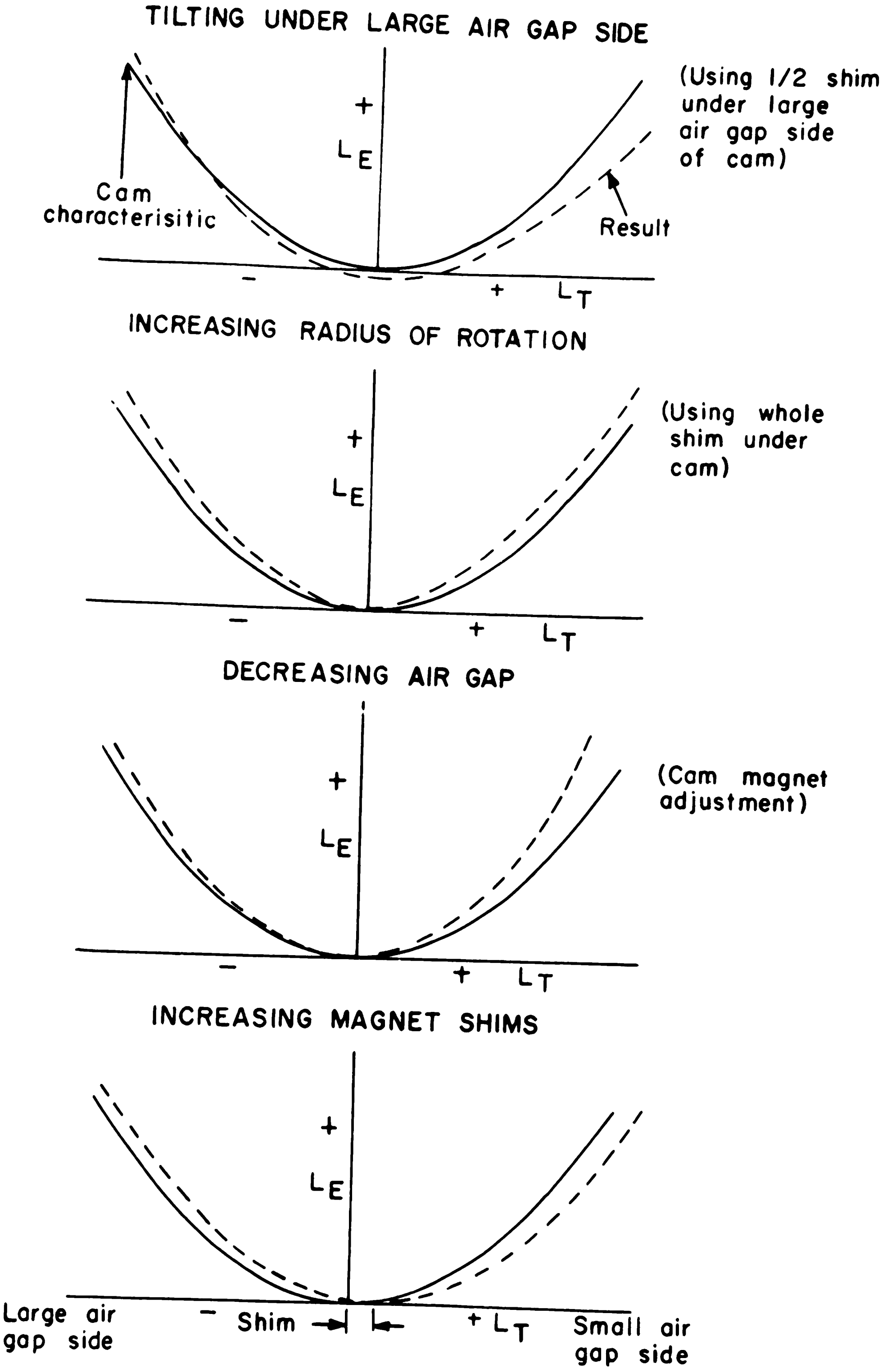


Figure 4-10. Amplifier Mk 121, Compensating Cam Alignment

SUPERELEVATION COMPUTER

1. Check to see that movable weight and driving lines slide freely. Mesh the superelevation sector gear with the pinion on the shaft of the upper gimbal pivot so that the sector gear is centered when the gimbal is centered.

2. Adjust the mesh for minimum, but definite, backlash. The drift readings obtained during the friction test should not be exceeded.

3. Set the magnet current at:

Mods	SA 2312192	SA 2312210
1 & 4	29.0 ma	29.72 ma
2 & 5	27.5 ma	27.72 ma
3	29.5 ma	29.72 ma

4. Adjust the superelevation weight rack travel so that it is centered when the range rate servo travels from -650 knots to +400 knots.

5. Move the superelevation weight to the minimum moment position (-650 knots).

6. Turn off the magnet current and measure the depression rate with a stop watch. Take several readings and, after throwing out the odd readings, average them.

7. Move the superelevation weight to the maximum moment position (+400 knots) and repeat step 6.

8. The difference between the readings obtained should be:

Mods 1 and 4	5.55 mils/second
Mods 2 and 5	6.15 mils/second
Mod 3	5.55 mils/second

If the difference is too great, lighten the superelevation weight by drilling holes in the center piece or filing the sliding block.

9. The depression rate at the minimum moment position should be 3.20 mils/second for Mods 1, 2 and 3, 3.50 mils/second for Mods 2 and 5. To obtain this, adjust the trim weight.

10. With the sight in the upright position and with the gyro running, take elevation readings at various current settings

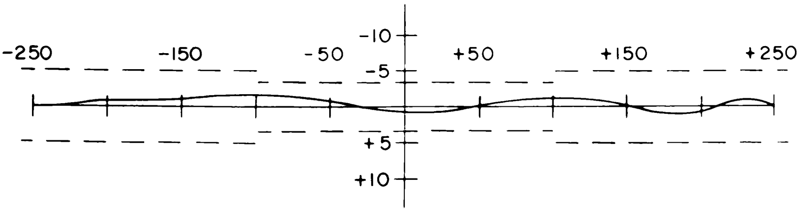


Figure 4-11. Amplifier Mk 121, Tolerance of Compensating Cam

shown in table 4-1 and at various range rate settings shown in table 4-2.

11. The average error in each case should not exceed 2 mils.

FINAL READINGS

1. Set in a range rate of -400 knots.

2. Set in values of magnet current (I_m) and rotate the turntable at the speeds indicated in table 4-3 or table 4-4, depending upon the turntable used. Read the values of horizontal lead angle and vertical lead angle in mils for clockwise and counterclockwise rotation for both the upright and 90-degree positions. Zero position for the upright position is CAGED; for the 90-degree

TABLE 4-1

SUPERELEVATION VERSUS MAGNET CURRENT FOR CHANGING RANGE (RANGE RATE—400 KNOTS)

SA 2312192

Mods 1 & 4		Mods 2 & 5		Mod 3	
Magnet Current (ma)	Superelevation (Mils)	Magnet Current (ma)	Superelevation (Mils)	Magnet Current (ma)	Superelevation (Mils)
51.74	-6.0	48.30	-6.6	51.74	-6.0
36.07	-12.5	34.26	-13.9	36.07	-12.5
28.70	-20.5	26.78	-22.2	28.70	-20.5
24.40	-28.5	22.77	-31.2	24.40	-28.5
21.25	-37.7	19.84	-41.5	21.25	-37.7

SA 2312210

Mods 1 & 4		Mods 2 & 5		Mod 3	
Magnet Current (ma)	Superelevation (Mils)	Magnet Current (ma)	Superelevation (Mils)	Magnet Current (ma)	Superelevation (Mils)
51.77	-5.8	48.30	-6.4	51.77	-5.8
42.81	-8.8	40.95	-9.2	42.81	-8.8
34.96	-13.5	32.62	-14.8	34.96	-13.5
29.72	-19.0	27.72	-20.8	29.72	-19.0
24.39	-28.4	24.10	-27.7	24.39	-28.4

TABLE 4-2

SUPERELEVATION VERSUS MAGNET CURRENT FOR CHANGING RANGE RATE (RANGE 3000 YARDS)

Range Rate (Knots)	Superelevation (Mils)		
	Mods 1 & 4 I_m=28.70 ma	Mods 2 & 5 I_m=26.78 ma	Mod 3 I_m=28.70 ma
+400	-46.6	-51.3	-46.6
+200	-38.0	-41.8	-38.0
0	-31.1	-34.2	-31.1
-300	-22.4	-24.6	-22.4
-650	-17.0	-18.6	-17.0

position, UNCAGED.

NOTE: Find train and elevation zero each time switch position is changed.

3. Adjust trimmer resistance (R11) as necessary to obtain the desired results as follows:

Correction %	R11 Ohms
+2	0
+1	5
0	15
-1	33
-2	82
-3	open

TABLE 4-3
LEAD ANGLE FOR TURNTABLE SA-2312192

Mods 1 and 4

Switch Position	Turntable Speed (Deg/Sec)	1000 Yards $I_m = 51.74$ ma		2000 Yards $I_m = 36.07$ ma		3000 Yards $I_m = 28.70$ ma		4000 Yards $I_m = 24.40$ ma		5000 Yards $I_m = 21.25$ ma	
		Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*
1	8.00	181.0	-6								
2	4.00	90.1	-6	191.0	-12.5						
3	2.00	45.0	-6	95.0	-12.5	153.0	-20.5	213.5	-28.5		
4	1.00			47.5	-12.5	76.1	-20.5	107.0	-28.5		
5	0.50					38.0	-20.5	53.4	-28.5	71.2	-37.7
6	0.25							26.7	-28.5	35.6	-37.7

Mods 2 and 5

Switch Position	Turntable Speed (Deg/Sec)	1000 Yards $I_m = 48.30$ ma		2000 Yards $I_m = 34.26$ ma		3000 Yards $I_m = 26.78$ ma		4000 Yards $I_m = 22.77$ ma		5000 Yards $I_m = 19.84$ ma	
		Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*
1	8.00	181.0	-6.6								
2	4.00	90.1	-6.6	191.0	-13.9						
3	2.00	45.0	-6.6	95.0	-13.9	153.0	-22.2	213.5	-31.2		
4	1.00			47.5	-13.9	76.1	-22.2	107.0	-31.2		
5	0.50					38.0	-22.2	53.4	-31.2	71.2	-41.5
6	0.25							26.7	-31.2	35.6	-41.5

Mod 3

Switch Position	Turntable Speed (Deg/Sec)	1000 Yards $I_m = 51.74$ ma		2000 Yards $I_m = 36.07$ ma		3000 Yards $I_m = 28.70$ ma		4000 Yards $I_m = 24.40$ ma		5000 Yards $I_m = 21.25$ ma	
		Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*
1	8.00	181.0	-6								
2	4.00	90.1	-6	191.0	-12.5						
3	2.00	45.0	-6	95.0	-12.5	153.0	-20.5	213.5	-28.5		
4	1.00			47.5	-12.5	76.1	-20.5	107.0	-28.5		
5	0.50					38.0	-20.5	53.4	-28.5	71.2	-37.7
6	0.25							26.7	-28.5	35.6	-37.7

*In 90-degree position all verticle readings should be zero.

TABLE 4-4

LEAD ANGLES FOR TURNTABLE AND PEDESTAL ADAPTER SA-2312210

Mods 1 & 4

TURNTABLE SPEED (DEG/SEC)	SWITCH POS. 7 I_m=51.77 ma		SWITCH POS. 6 I_m=42.81 ma		SWITCH POS. 5 I_m=34.96 ma		SWITCH POS. 4 I_m=29.72 ma		SWITCH POS. 2 I_m=24.39 ma	
	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*
6	131.0	-5.8	199.0	-8.8						
3	65.4	-5.8	99.5	-8.8	153.0	-13.5	213.5	-19.0		
1 1/2			49.7	-8.8	76.1	-13.5	107.0	-19.0		
3/4					38.0	-13.5	53.4	-19.0	80.1	-28.4
3/8							26.7	-19.0	40.0	-28.4

Mods 2 & 5

TURNTABLE SPEED (DEG/SEC)	SWITCH POS. 7 I_m=48.30 ma		SWITCH POS. 6 I_m=40.95 ma		SWITCH POS. 5 I_m=32.62 ma		SWITCH POS. 4 I_m=27.72 ma		SWITCH POS. 2 I_m=24.10 ma	
	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*
6	131.0	-6.4	191.0	-9.2						
3	65.4	-6.4	95.0	-9.2	153.0	-14.8	213.5	-20.8		
1 1/2			47.5	-9.2	76.1	-14.8	107.0	-20.8		
3/4					38.0	-14.8	53.4	-20.8	71.2	-27.7
3/8							26.7	-20.8	35.6	-27.7

Mod 3

TURNTABLE SPEED (DEG/SEC)	SWITCH POS. 7 I_m=51.77 ma		SWITCH POS. 6 I_m=42.81 ma		SWITCH POS. 5 I_m=34.96 ma		SWITCH POS. 4 I_m=29.72 ma		SWITCH POS. 2 I_m=24.39 ma	
	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*	Horiz.	Vert.*
6	131.0	-5.8	199.0	-8.8						
3	65.4	-5.8	99.5	-8.8	153.0	-13.5	213.5	-19.0		
1 1/2			49.7	-8.8	76.1	-13.5	107.0	-19.0		
3/4					38.0	-13.5	53.4	-19.0	80.1	-28.4
3/8							26.7	-19.0	40.1	-28.4

*In 90-degree position all verticle readings should be zero.

4. Average the errors of all horizontal readings for both upright and 90-degree positions.

5. Record the maximum individual errors for all horizontal readings.

6. Average the error of all vertical readings for both upright and 90-degree positions.

7. Record the maximum individual errors for all vertical readings.

8. For both horizontal and vertical readings, the average of the errors shall not be greater than 4 mils.

9. For both horizontal and vertical readings, no individual error shall be greater than 12 mils.

10. All final readings shall be repeatable within ± 3 mils and in no case shall the over-all average (horizontal and vertical) exceed 4 mils.

CAGING DEVICE ZEROING

On all Mk 31 gun sights, regardless of Mod, the gyro must be zeroed with the superelevation computer disengaged prior to aligning the caging device. The superelevation computer, in the engaged position, exerts a force on the gimbal frame which causes downward precession of the gyro that moves the reticle position below zero on the test stand sight scale. When installed and in the caged position, the caging device should hold the gyro in its zero reference position regardless of whether the superelevation computer is engaged, the gyro is running, or current is flowing in the magnet current circuitry.

All zeroing should be done with the gun sight mounted on the turntable and in the upright position, figure 4-7.

The method of zeroing the caging device will depend upon the mod of gunsight being overhauled. Separate instructions follow for zeroing the caging device on gun sight Mod 3, Mods 4 and 5, and Mods 1 and 2 after NAVWEPS ORDALT 4330 has been accomplished.

CAGING DEVICE ZEROING PROCEDURE (MOD 3 GUN SIGHTS).

1. Deenergize gyro and magnet current circuit.
2. Remove test eyepiece and gyro retaining ring (SA 2312203), figure 4-7.
3. Secure the telescope eyepiece to the sight case rear cover and attach the caging device without tightening the screws on the device.
4. With the superelevation computer disengaged and the caging knob in the UNCAGED position, fasten the rear cover to the sight case. Do not dowel the cover at this time.

   NOTE: Although the caging device is not aligned at this point it serves as a retaining ring and protects the gyro.

5. With the gyro running and approximately 60 ma flowing in the magnet current circuit, move the sight case on the turntable until the zero position on the sight scale is visible through the reticle. When this condition has been satisfied, the zero reference position of the gun sight is established.
6. Clamp the sight case to the turntable so that it does not shift until the remaining steps of this

procedure are completed.

7. With the gyro motor de-energized and approximately 60 ma flowing in the magnet current circuit, cage the gyro and adjust the position of the caging device on the rear cover and/or the position of the rear cover on the sight case until the caged position of the gyro coincides with the zero reference position within 1/2 mil.

8. When the zero position is located, tighten the caging device and rear cover mounting screws and dowel the caging device to the cover and the cover to the sight case.

   NOTE: If the gyro is removed from the sight case or relocated in the gimbal frame during overhaul, the sight case rear cover and/or the caging device may require redoweling.

9. If more correction is necessary than can be obtained by shifting the position of the caging device on the rear cover and/or the rear cover on the sight case, additional correction can be obtained by slotting the mounting holes in the rear cover.

   CAUTION: To avoid damage, remove the rear cover and the caging device and eyepiece from the rear cover prior to the slotting operation.

10. Remove the rear cover with the caging device and eyepiece after the zero reference has been established and the gyro caging device located and engage the superelevation computer.

11. Replace and locate the rear cover on the sight case, cage the gyro and energize the gyro motor and magnet current circuit to check caging device zero.

CAGING DEVICE ZEROING PROCEDURE (MODS 4 AND 5 GUN SIGHTS).

1. With the superelevation computer disengaged, the gyro retaining ring (SA 2312203) in place, and approximately 60 ma flowing in the magnet current circuit, remove the sight case on the turntable until the zero position on the sight scale is visible through the reticle. When this condition has been satisfied, the zero reference position of the gun sight is established.

2. Clamp the gun sight case to turntable so that it does not shift until the remaining steps of this procedure are completed.

3. Turn off power to the gyro and magnet current circuit and secure and engage the superelevation computer.

4. Secure and dowel the rear cover to the sight case.

5. Draw the caging servomotor

leads through the hole provided in the rear cover and then through the hole in the caging support before fastening the caging support to the rear cover.

6. Using wedges and screws, mount the caging support on the rear cover of the sight case and leave play for final positioning. The caging spring will hold the caging linkage in the caged position.

7. With the gyromotor deenergized and approximately 60 ma flowing through the magnet current circuit, adjust the position of the caging support on the rear cover until the caged position of the gyro coincides with the zero reference position of the gyro within 1/2 mil.

8. After locating the correct position of the caging support, tighten the six screws that secure it to the rear cover. Make all future zeroing adjustments by moving the caging support and not the rear cover.

9. Secure the caging cover assembly, less the servomotor housing cover, to the caging support.

   NOTE: The caging cover should be completely assembled and aligned prior to mounting on the caging support.

10. Connect all leads to the terminals in the servomotor housing. Energize and deenergize the caging servomotor several times to see that it is functioning properly.

11. Secure the servomotor housing cover to the caging cover.

12. Mount the eyepiece adapter being careful to first align the tongue of the focusing knob shaft with the slot in the coupling on eyepiece focusing gear shaft.

    NOTE: Although the design drawing (dwg. 2094690) shows the eyepiece adapter doweled to the rear cover. This procedure has been proven unnecessary and discontinued.

CAGING DEVICE ZEROING PROCEDURE (MODS 1 AND 2 AFTER ORDALT 4330).

1. Deenergize the gyro and the magnet current circuit.

2. Remove the test eyepiece and the gyro retaining ring (SA 2312203), figure 4-7.

3. Secure the telescope eyepiece to the rear cover of the sight case. Attach the caging support but do not tighten the mounting screws.

4. With the superelevation computer disengaged, the caging spring released, and the caging linkage in the uncaged position, fasten the rear cover to the sight

case. Do not dowel the cover at this time.

NOTE: Although the caging device is not aligned at this time, it serves as a retaining ring and protects the gyro.

5. With the gyro running and approximately 60 ma flowing in the magnet current circuit, move the sight case on the turntable and/or adjust the position of the rear cover until the zero position on the sight scale is visible through the reticle. When this condition has been satisfied the zero reference position of the gun sight is established.

NOTE: When looking into the eyepiece, the reticle should be seen through the center of the lens. This is an ideal condition and is not always obtainable.

6. Clamp the sight case to the turntable so that it does not shift until zeroing is completed. Dowel the rear cover to the sight case.

7. Attach the caging spring to the spring anchor. The caging linkage will now remain in the caged position.

8. With the gyromotor deenergized and approximately 60 ma flowing in the magnet current circuit, adjust the position of the caging support on the rear cover until the caged position of the gyro coincides with the zero reference position within 1/2 mil.

9. After locating the correct position of the caging support, tighten the screws that secure it to the rear cover. Make all future zeroing adjustments by moving the caging support and not the rear cover.

10. With current to the magnet current circuit off, remove the rear cover with caging support and eyepiece attached. Engage the superelevation computer.

11. Draw the caging servomotor leads through holes provided in the rear cover and caging support and fasten the rear cover to the sight case.

12. Secure the caging cover assembly, less the servomotor housing cover, to the caging support.

NOTE: The caging cover should be completely assembled and aligned prior to mounting on the caging support.

13. Connect all leads to the terminals in the servomotor housing. Energize and deenergize the caging servomotor several times to see that it is functioning properly.

14. Secure the servomotor housin cover to the caging cover.

15. Cage the gyro and energize

the gyromotor and magnet current circuit to check caging device zero.

PICKOFF ZEROING AND GRADIENT CHECK

1. With the sight in the upright position, with the gyro running and CAGED, adjust the traverse and elevation pickoffs to a null of 0.3 volts or less by using the same procedure as previously used to obtain the approximate null.

2. To zero the traverse pickoff, it is necessary to remove the nutation damper, but the final null must be checked with the nutation damper in place.

   CAUTION: Do not uncage the gyro with the nutation damper removed.

3. With the gyro running and uncaged, rotate the turntable SA 2312192 at a speed of 2 degrees/second, SA 2312210 at 1 1/2 degrees/second.

4. Set the magnet current at approximately 23.7 ma to give a lead angle at 174.5 mils.

5. Adjust the traverse pickoff trim potentiometer (R1) until the pickoff output across J4 and J5 of the gyro start and magnet current control box is 18 ± 0.2 volts with 115 volts excitation. Voltage should be measured with a high impedance vacuum-tube voltmeter. Line voltage should be measured with the same meter.

6. Rotate the sight to the 90-degree position and adjust the elevation trim potentiometer R6. Measure the output across J4 and J5 of the gyro start and magnet current control box.

7. Using a phase-shift meter, measure the phase shift of the elevation and traverse pickoffs with respect to line voltage. Both signals must be within 10 degrees of line voltage when displacement of 30 degrees is generated.

CONTROL UNIT

1. Connect a Gyro Motor Mk 31 or equivalent to terminals 3, 4, and 5 of the control unit.

2. Apply 115 volts, 400 cycles to terminals 2 and 3. This power must be 115 volts ±5 percent and 400 cycles +4 percent, -2 percent.

3. Relay K1 should pick up immediately when power is applied and should drop out as the motor comes up to its full speed of 11,800 rpm ± 4 percent and the motor current drops. Relay K1 should drop out within one minute.

4. Remove the power for two seconds, then reapply. Relay K2 should not open when power is removed nor

when power is reapplied.

5. Remove power for five to ten seconds, then reapply. Relay K2 should drop out before power is reapplied, then pick up within three to seven seconds after power is reapplied.

6. Energize relay K3 and check to see that a completed circuit exists between each of the following sets of terminals:

   9 and 10
   15 and 19

7. De-energize K3 and check to see that a completed circuit exists between each of the following sets of terminals:

   6 and 7 (27.2 kilohms)
   11 and 12
   13 and 14
   15 and 16
   17 and 18 (39 kilohms)
   19 and 20
   17 and 19 (3.56 kilohms)
   7 and 17 (148 kilohms)

RESISTOR PACK

Test for the proper resistance between each of the terminals shown on table 4-5.

RANGE SERVO UNIT.

1. Using a 500-volt DC insulation tester, measure the insulation resistance of all wiring with respect to the chassis. This resistance should be at least 3 megohms.

2. Rotate the range dial in both directions and check the mechanical limits of the stop mechanism. The lower limit should be at 450 yards and the upper limit at *8900 yards, Mods 1, 2, 4 and 5, or 266 yards and 5333 yards, Mod 3.

3. Rotate the range dial in the clockwise direction and make sure that the limit switch (S1) opens below 490 yards, Mods 1, 2, 4 and 5, or 290 yards, Mod 3, and before the mechanical stop is reached.

4. Rotate the range dial in the counterclockwise direction and make sure that the limit switch (S1) opens above 7900 yards, Mods 1, 2, 4 and 5, or 4680 yards, Mod 3, and before the mechanical stop is reached.

   NOTE: The resistance between J1-20 and J1-21 should be 210 ohms ± 10 percent when S1 is open.

5. Set the gear train at 3500 yards, Mods 1, 2, 4 and 5 or 3200 yards, Mod 3 as determined by the range dial and the scribe mark on the vernier gear. Lock the gear train in this position.

6. Make sure that all the potentiometers are set with their internal mechanical limits beyond the servo mechanical limits to prevent damage to the potentiometers.

---

*8850 yards for Mod 1 serial numbers 75 through 82.

TABLE 4-5

RESISTOR PACK RESISTANCES

RP No.	Bridge Accuracy	Resistance (Ohms)		
		Mods 1 & 4	Mods 2 & 5	Mod 3
1-17	0.01%	472 ± 0.472	0	*
2-17	0.01%	521 ± 0.521	50 ± 0.05	*
3-17	0.01%	571 ± 0.571	102 ± 0.01	*
4-17	0.01%	622 ± 0.622	154 ± 0.154	*
5-17	0.01%	674 ± 0.674	208 ± 0.208	*
6-17	0.01%	721 ± 0.721	258 ± 0.258	*
7-17	0.01%	769 ± 0.769	309 ± 0.309	*
8-17	0.01%	818 ± 0.818	360 ± 0.818	*
9-17	0.01%	867 ± 0.867	413 ± 0.413	*
10-17	0.01%	918 ± 0.918	467 ± 0.467	*
11-17	0.01%	969 ± 0.969	522 ± 0.522	*
12-17	0.01%	1021 ± 1.021	578 ± 0.578	*
13-14	0.01%	272 ± 1.712	301 ± 1.89	320 ± 1.90
13-18	0.1%	160 ± 1.60	161 ± 1.61	129 ± 1.29
13-25	0.1%	91.7K ± 4.95K	91.8K	92.35K
13-19	0.1%	696 ± 2.136	785	1348
28-23	0.1%	18 ± 0.18	15.5 ± 0.155	14.5 ± 0.145
28-29	0.1%	36 ± 0.36	30.9 ± 0.309	29 ± 0.29
28-30	0.1%	54 ± 0.54	46.4 ± 0.464	43.5 ± 0.435
28-31	0.1%	72 ± 0.72	61.8 ± 0.618	58 ± 0.58
28-24	0.1%	90 ± 0.90	77.3 ± 0.773	72.5 ± 0.725
26-20	0.5%	220K ± 11K	220K ± 11K	240K ± 12K
26-27	0.5%	82K ± 4.1K	75K ± 3.75K	75K ± 3.75K
26-22	0.5%	125K ± 6.25K	114K ± 5.07K	131K ± 6.55K
26-21	0.5%	147K ± 7.35K	138K ± 6.9K	133K ± 6.65K

*Not used on Mod 3

NOTE: Use a five-place resistance bridge for adjusting potentiometers.

7. Adjust the parallax potentiometer (P3) to measure 16,400 ± 164 ohms between J1-7 and J1-8.

8. Adjust the parallax potentiometer (P4) to read 3300 ± 66 ohms between J1-10 and J1-11.

9. Measure the total resistance of P1B to within 0.1 percent. Set P5 to read:

$$R_{p}5 = 0.025 \times R_{p}1B \pm 0.1 \text{ percent}$$

10. Adjust P1B to read the following resistance between J1-2 and J1-3:

$$R(J1\text{-}2 \text{ to } J1\text{-}3) = 0.3794\,(R_{p}1B + R_{ps}) \pm 0.1 \text{ percent}$$

11. On Mods 1, 2, 4 and 5, the fuze time potentiometer (P1A) will be set automatically when P1B is set. There is no fuze time potentiometer on Mod 3.

12. Adjust the magnet current potentiometer (P2) to read 700±0.7 ohms, Mods 1, 2, 4 and 5, or 544±0.6 ohms on Mod 3.

13. Rotate the gearing to the lower mechanical stop.

14. Place a 1/4-inch pulley wheel on the shaft of the servo wheel.

15. Using a spring scale, determine the slipping point of the clutch. This should be 8 ounces ± 1 ounce.

16. Using the range and range rate test box (SA 2312216), check the starting and running torques of the servomotor in both the clockwise and the counter-clockwise directions by observing the voltages of the meter. These voltages should exceed six volts starting, five volts running.

POWER SUPPLY

Table 4-6 lists the positions of switches S1 through S8 during the following tests.

> CAUTION: Avoid accidentally shorting the supply output.

1. PRELIMINARY. Remove all test links from the power supply and attach the test cable between the power supply and the test stand. On the power supply, turn potentiometer P-3 fully clockwise and P-1 fully counterclockwise. On the test stand, close switches S1, S2, S5, and S6. Connect an AC voltmeter between test points TP3 and TP4. Turn power ON and set the variac for an input of 115-volts AC as indicated by the voltmeter. Allow 1/2 hour warmup before preceeding.

2. PRE-AMPLIFIER BALANCE. On the power supply, connect a high impedance differential DC voltmeter between test points TP(PS)1 and TP(PS)2. Adjust potentiometer P-1 fo a null as indicated on the DC voltmeter. Lock P-1 and recheck.

   NOTE: If a null cannot b obtained, disconnect the lead on terminal 7 of AR- and connect permanently a 27,900-ohm 1/2-watt resistor between the terminal and the lead removed.

3. BOOSTER AMPLIFIER GAIN. Open switches S1 and S6. Close switch S7. Adjust th load control for a load for 100 ma as indicated by the milliammeter on the test stand. Connect the high impedance DC voltmeter between test points TP5 and TP6. Slowly rotate potentiometer P-1 clockwise until the high impedance DC voltmeter indicates 250-volts DC ± 2.5 volts. Lock P-1 and recheck.

   NOTE: The output of the power supply is determined in part by the load while making this test/adjust. The output shoul come within tolerance wit a load of between 90 and 110 ma.

4. LOOP GAIN. Open switches S2 and S7. Close switches S3 and S6. Adjust

potentiometer P-4 for 250-volts DC ± 0.25 volts as indicated on a high impedance differential voltmeter .

5. TRANSIENT RESPONSE. Close switch S4. Open switches S5 and S6. Ground the osciloscope to both test points TP1 and TP8. Connect the scope to receive an external positive trigger from test point TP2. Connect the scope video input to test point TP7. Set the scope base/time selector to 0.1 second and the vertical volt/div selector to 0.1 volt. Close and open switch S8 while viewing the scope pattern. Adjust potentiometer P-3 to obtain the waveform described on figure 4-13. The amplitude of the waveform is not critical. Lock P-3 and recheck. After potentiometer P-3 has been set, observe the differential voltmeter with the sensitivity set on 1.0 volt and determine that the voltage transient is not greater than 0.5 volts and that the recovery time does not exceed 0.5 seconds.

6. REGULATION. Close switches S5, S6, and S7. Adjust the variac to obtain 121-volts AC input. Adjust the load control for 110 ma and record the voltage indicated on the differential voltmeter. Readjust the load to 70 ma and record the differential voltmeter indication. Readjust the variac for an input of 109-volts AC and record the differential voltmeter indication. Readjust the load to 110 ma and record the differential voltmeter indication.

The four recorded output voltages must be within ± 0.25 volts of nominal.

7. HASH. Readjust the input to 115-volts AC with the variac and the load to 110 ma. Disconnect the differential voltmeter and oscilloscope. Connect the scope across the output, test points TP5 and TP6. Set the scope for a positive, internal, auto trigger, and the base/time selector to 100 microseconds. The spikes observed on the output should not exceed 1.5 divisions, centerline to peak, with the scope vertical and the volt/div selector set on 0.1 volt.

8. RIPPLE. Disconnect the oscilloscope and connect the AC voltmeter across test points TP5 and TP6. The peak-to-peak AC component of the output should not exceed 0.2 volts.

MAGNET CURRENT SUPPLY

1. Connect a resistance bridge across MS-3 and MS-8. Set the MRU current adjust potentiometer (P2) to obtain 1590.8 ohms as indicated on a wheatstone bridge. Lock P2 and recheck its setting.

2. Connect the resistance bridge across MS-1 and MS-2. Set the branch "A" potentiometer (P1) to obtain 1123 ohms for Mod 1 units or 888 ohms for Mod 2 units as indicated on

Table 4-6. Status of Test Switches During the Tests

0 = Switch Open
X = Switch Closed

*Close and open S8 while viewing oscilloscope pattern

SWITCH	TEST NUMBER							
	1	2	3	4	5	6	7	8
S1	X	X	0	0	0	0	0	0
S2	X	X	X	0	0	0	0	0
S3	0	0	0	X	X	X	X	X
S4	0	0	0	0	X	X	X	X
S5	X	X	X	X	0	X	X	X
S6	X	X	0	X	0	X	X	X
S7	0	0	X	0	0	X	X	X
S8	0	0	0	0	0*X	0	0	0

a wheatstone bridge. Lock P1 and recheck its setting.

3. Connect the numbered leads from SA 2312187 or equivalent to the terminal board on the magnet current supply.

4. Energize the unit and allow a 10 minute warmup before proceeding.

5. Jumper TP-1 and TP-2. Connect a DC voltmeter across TP-3 and TP-4.

6. Adjust the discriminator zeroing potentiometer (P3) for a zero volt indication on the voltmeter.

7. Set the decade resistance box for 1060 ohms.

8. Plug a DC milliampere meter (0 to 100 ma) into J-1.

9. Adjust trimmer potentiometer (P4) to obtain 20 ma in the magnet circuit.

10. Remove the jumper between TP-1 and TP-2 and the voltmeter from TP-3 and TP-4.

11. Place a digital voltmeter (KinTel model 451 with Model 471 Digital Readout or equivalent) across TP-5 and TP-6.

12. Holding 20 ma in the magnet circuit, adjust P3 for a stable indication of 0.0513-volts DC at TP-5 and TP-6 or measure the current flow as indicated in Fig. 4-12.

13. Set the decade resistance box to obtain a magnet current of 30 ma and record the indication of the voltmeter across TP-5 and TP-6.

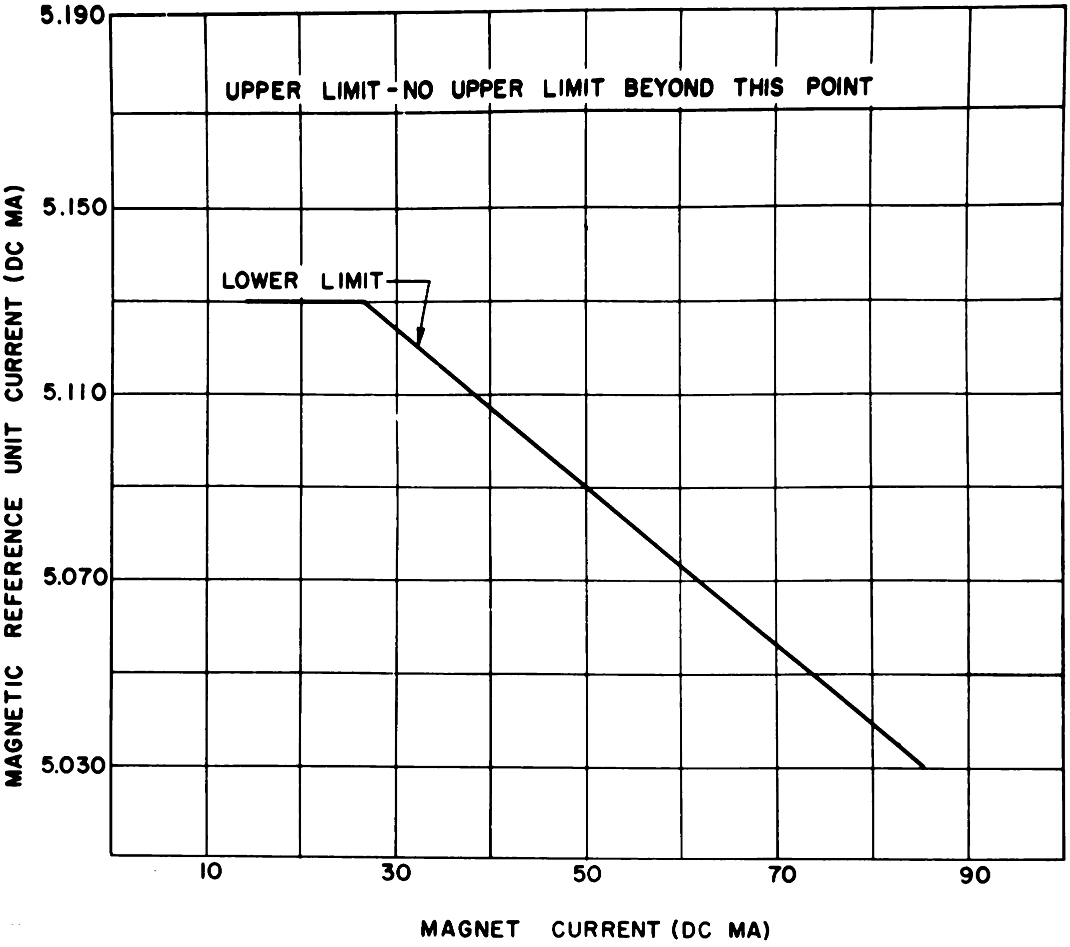


Figure 4-12. Amplifier Mk 121, Magnetic Reference Unit Current Versus Magnet Current

14. Repeat step 13 for magnet currents of 40, 50, 60, and 70 ma.

15. Plot a gain curve and compare the results with figure 4-12. Realignment of P3 may be required to bring the results into conformity with figure 4-12.

RANGE AND RANGE RATE SERVO AMPLIFIERS

1. Connect all numbered leads from test panel (SA2312183 or equivalent) to the corresponding terminals on the servo amplifiers. The servomotor will not turn over since the fixed-phase leads are wired through a normally open push-button switch. Leads 9 and 10 are connected to a variable 40,000-ohm input circuit which simulates the radar input. Leads 11 and 12 are connected to the tachometer feedback leads of the servo amplifier. Leads 13 and 14 are connected to the servomotor

control phase load.

NOTE: Do not energize the fixed-phase leads of the servomotor during this portion of the test.

2. Connect a DC microammeter (0-30) into J1 and an AC electronic voltmeter into J2 of the test panel.

3. Close S2 on the test panel.

4. Adjust the servo amplifier balance potentiometer (P1) so that a zero input gives a null signal.

5. Close S1 on the test panel.

6. Vary the gain potentiometer (P2) so that a -10 microampere signal causes an output of 30 volts AC. Check that a +10 microampere input also causes a 30 volt AC output. Refine the balance adjust if required.

7. Lock P1 and P2 securely.

8. Vary R1 on the test panel and plot the output signal for 0, 4, 16, and 20 microampere inputs.

9. Reverse the polarity of the signal by throwing S4 on the test panel and repeat step 8.

10. Open S1 on the test panel. Short circuit C3 in the Servo Amplifier.

11. Connect a voltmeter into J3. Close S3 on the test panel.

12. Vary the variac T1 on the test panel from 0 to 3 volts AC in steps of one volt.

13. Reverse the phase of the signal by throwing S5 on the test panel and repeat step 12. The gradient obtained should be:

$$\frac{10 \text{ volts}}{1 \text{ volt}} \pm 20\%$$

14. Remove the jumper from C3.

SYSTEMS TEST

1. Connect the gun sight and amplifier to the system test box (SA 2312217).

2. Turn the 115-volt, 400-cycle power to ON.

3. Check the gyro rotation. The motor should rotate in the counterclockwise direction when viewed from the caging pin end of the motor.

4. Make sure that relay K1 drops out within one minute of starting time. There will be an audible click when K1 drops out.

5. Place a type K potentiometer with voltage divider across TP4 (-) and TP3 (±) of the power supply.

6. The output of the power supply should measure 250 volts ± 0.1 percent.

7. Turn the 115-volt, 400-cycle power to OFF.

8. Set the amplifier test

panel selector switch to MAGN. CURR.

9. Set the range selector switch on the systems test box to 3500 yards and the range rate selector switch to -200 knots. Throw the power to ON.

10. The range dial on the range servo unit should drive to 3500 yards and the range rate dial on the gun sight to -200 knots as soon as power is applied. The magnet current should come on within five seconds after relay K1 drops out.

11. Turn the 115-volt, 400-cycle power switch to OFF, then ON again within 2 seconds.

12. The magnet current should come on immediately.

13. Turn the test selector switch on the amplifier test panel to the ± 250 volt position, then to the 115 volt position. The meter needle should be within the green band region of the dial when the switch is in either position.

14. Check the operation of the illumination control on the gun sight. Counterclockwise rotation of the knob should increase the brightness of the reticle image over the entire range of travel.

    NOTE: To prevent damage to the control a stop has been added on Mods 4 and 5 to limit travel.

15. Turn the ILLUM CONTROL switch on the amplifier test panel to the ON position.

16. Check to make sure that the TRACK signal comes on.

17. Turn the range rate switch on the system test box to 0 knots. The range rate servo in the gun sight should drive to 0 knots as indicated by the range rate dial. The scribe mark on the vernier gear should line up with the index mark. If it does not, check the setting of the response potentiometer (P1).

18. Turn the range rate switch on the system test box to all of its other positions. The range rate servo dial should correspond to the range rate switch setting in each case.

19. Turn the range switch on the system test box to all of its positions. The range dial of the range servo unit in the amplifier should correspond to the switch setting in each case. If the dial and vernier do not line up with the index mark at the 3500-yard setting, check the setting of the range response potentiometer (P1B).

20. Set the range rate switch on the system test box to +200 knots and the IV switch on the test panel of the amplifier to:

Mod 1	2650
Mod 2	2500
Mod 3	2800

21. Plug a milliammeter (0-100 ma range) into J1 of magnet current supply of the amplifier.

22. Measure the magnet current at J1 with the setting of the system test box range switch indicated in table 4-7.

    NOTE: The information contained in tables 4-7, 4-8, and 4-9 is valid for room ambient temperatures between 60 and 100 degrees Fahrenheit. Sight errors may be introduced if this information is used outside of the specified range.

23. Repeat with the range rate set at -400 knots and measure the magnet current as shown in table 4-8.

24. Turn the range switch to 3500 yards and the range rate switch to -400 knots.

25. Turn the IV switch to the settings and read magnet current as indicated in table 4-9.

26. Turn the system test box DC power switch to ON and the TRACK switch to OFF.

27. Push the SLEW button and read magnet current. The magnet current should not change after range has been driven into a limit.

28. Turn the DC power switch to OFF.

TABLE 4-7

MAGNET CURRENT FOR VARIABLE RANGE, FIXED IV AND RANGE RATE OF +200 KNOTS

RANGE SWITCH POSITION	RANGE MAGNET CURRENT (ma)			
	MOD 1	MOD 2	MOD 3	ACCURACY
1000 yards	54.05	49.53	52.93	±3%
2000 yards	36.85	34.00	35.17	±2%
3500 yards	26.15	24.24	24.61	±2%
4500 yards	22.35	22.35	20.98	±2%

TABLE 4-8

MAGNET CURRENT FOR VARIABLE RANGE, FIXED IV AND RANGE RATE OF —400 KNOTS

RANGE SWITCH POSITION	RANGE MAGNET CURRENT (ma)			
	MOD 1	MOD 2	MOD 3	ACCURACY
1000 yards	52.00	46.52	51.81	±3%
2000 yards	36.45	33.35	35.32	±2%
3500 yards	26.25	24.39	25.02	±2%
4500 yards	22.55	21.08	21.42	±2%

TABLE 4-9

MAGNET CURRENT FOR VARIABLE IV, FIXED RANGE AND RANGE RATE

Mod 1		Mod 2		Mod 3	
IV Switch	Magnet Current	IV Switch	Magnet Current	IV Switch	Magnet Current
2475	26.09	2325	24.25	2625	25.72
2500	26.25	2350	24.39	2650	25.02
2525	26.42	2375	24.53	2675	25.16
2550	26.58	2400	24.67	2700	25.30
2575	26.75	2425	24.82	2725	25.44
2600	26.91	2450	24.97	2750	25.58
2625	26.09	2475	24.25	2775	25.72
2650	26.25	2500	24.39	2800	25.02
2675	26.42	2575	24.53	2825	25.16
2700	26.58	2550	24.67	2850	25.30
2725	26.75	2575	24.82	2875	25.44
2750	26.91	2600	24.97	2900	25.58

29. Push the SLEW button and read magnet current. Magnet current should increase to at least 78 ma.

30. Set the range rate switch at -200 knots and the range switch at 4500 yards.

31. Turn the DC power switch to ON.

32. Record the time required for the range dial to travel 2000 yards.

33. Repeat steps 30, 31, and 32 for a range rate of ± 200 knots.

34. The times taken in steps 32 and 33 should agree within five seconds. If they do not, adjust R2 of the control unit until balanced readings are obtained. If R2 of the control unit does not give adequate adjustment, adjust P1 of the range servo unit for balance.

35. Repeat steps 30 through 34 until balance within the acceptable limits of five seconds has been obtained.

36. Set the range rate switch at -400 knots and the range switch at 4500 yards.

37. Turn the DC power ON and record the time required for the range dial to move 2000 yards. This should be 8.9 seconds ± 20 percent.

38. Repeat steps 36 and 37 for a range rate of -600 knots.

39. Turn the DC power switch OFF.

40. Set the IV switch at 2600.

41. Uncage the gyro and displace the sight case until the calibration index lines up with the outer dot on the calibration scale.

42. Press the SLEW button on the system test box. There should be a definite increase in the precession rate as the gyro returns to zero position.

43. Repeat steps 40 through 42 with an IV setting of 2750.

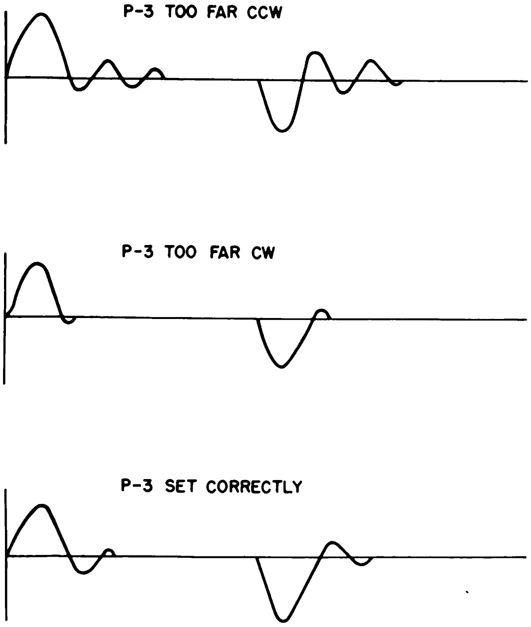
FINAL ASSEMBLY AND COLLIMATION OF GUN SIGHT

1. Remove the sight from the turntable if it has not been removed previously.

2. Remove the test collimating lens.

3. Remove the electrical connection and calibration unit extensions.

4. Solder trimmer resistor (R11) in place in the electrical connection and calibration unit.


P-3 TOO FAR CCW

P-3 TOO FAR CW

P-3 SET CORRECTLY

NOTE
CLOSE SWITCH S8 AND IMMEDIATELY OPEN IT. THIS WILL CAUSE THE SECOND WAVEFORM (NEGATIVE) TO APPEAR.

Figure 4-13. Amplifier Mk 121, Power Supply Transient Response

5. Reinstall the electrical connection and calibration unit and any covers which have been removed (except the top cover).

6. Install the front window.

7. Place the sight on the collimating fixture (SA 2311454).

8. Adjust the traverse line of sight by rotating the sight around its front foot until the sight's zero position and the zero position of the collimating fixture coincide. This adjusts the line of sight so that it is parallel to the lower surface of the mounting feet within ± 1/2 mil when the gyro is in its electrical and mechanical zero position (CAGED). The line of sight is also parallel, within ± 1/2 mil, to a line joining the centers of the rear mounting holes.

9. Clamp the sight in this position and ream the rear mounting holes to size using SA 2312214.

10. Adjust the elevation line of sight with the mirror adjusting screw.

11. Replace the top cover.

PURGING AND CHARGING

Prior to purging, check the desiccator unit and if the desiccant is pink, replace it with a fresh unit. Desiccator units with sintered bronze containers for the desiccant can be reactivated by placing the entire unit in an oven at 350 degrees Fahrenheit for two or three hours or until the desiccant turns blue. The same method can be used for units using cloth containers for the desiccant except that the desiccant should be removed from the bag prior to baking and returned to the bag after drying.

1. Attach the dry nitrogen charging equipment to the air inlet valve on the left side of the sight case and remove the drain plug.

2. Allow dry nitrogen under four pounds per square inch pressure to flow into the gun sight and out the drain plug opening.

3. When the gun sight is well purged (3 to 5 minutes), remove the telescope vent screw and washer, figures 2-8 and 2-9, and reinstall the drain plug.

4. Allow the nitrogen to flow into the gun sight and out through the vent screw opening.

5. When the eyepiece is well purged (1 to 2 minutes), decrease nitrogen pressure to 1.5 pounds per square inch and reinstall the vent screw and its nylon washer.

6. Charge the gun sight with dry nitrogen under pressure of 1.5 pounds per square inch maximum.

7. Close the air inlet valve and remove the charging equipment.

Appendix A

TEST EQUIPMENT AND FIXTURES

Shop Accessories Required to Overhaul and Test

Amplifier Mk 121

SA 2312183, Servo amplifier test fixture
SA 2312187, Magnet current test fixture
SA 2312216, Range and range rate test fixture
SA 2312217, Systems test fixture

Gun Sight Mk 31

SA 2311451, Spin axis centering fixture
SA 2311452, Mirror balancing fixture
SA 2311453, Gyro and gimbal balancing fixture
SA 2311454, Collimating fixture
SA 2312192, Turntable
SA 2312203, Gyro retaining ring
SA 2312205, Eyepiece mounting bracket (Mods 1 and 2 only)
SA 2312206, Collimating lens
SA 2312207, Eyepiece group (Mods 1 and 2 only)*
SA 2312210, Pedestal adapter kit
SA 2312211, Shipping bracket
SA 2312212, Gimbal centering fixture
SA 2312213, Pickoff centering fixture
SA 2312214, Reamers
SA 2312215, Gyro start and magnet current supply box**
SA 2312218, Gyro start and magnet current panel box**
SA 2312219, Cradle**
SA 2312220, Collimator tube***

---

*Used with SA 2312205
**Used with SA 2312210
***Used with SA 2311454

Index of Equipment Required for Specific Tests or Operations

Amplifier Mk 121

Test or Operation	Equipment Required
Control unit	Electric timer, Standard Electric Time Co., Type S-10 or equivalent Multimeter, Simpson Model 260 or equivalent Mk 31 gyro motor or equivalent
Magnet current supply	SA 2312187 Precision potentiometer, L&N Type K or equivalent Multimeter, Simpson Model 260 or equivalent Decade resistance box
Power supply	SA Weston-analyzer Mod 980 Fluke Differential Voltmeter Tektronic 310 Oscilloscope Hewlett Packard 400D AC-VTVM
Range servo unit	SA 2312216 Insulation tester, 500 volts DC Five-place resistance bridge L&N Cat. No. 4725 Spring scale 0-10 ounce 1/4-inch pulley for servomotor shaft
Resistor pack	Five-place resistance bridge L&N Cat. No. 4725
Servo amplifiers	SA 2312183
Systems tests	SA 2312217 Precision potentiometer, L&N Type K or equivalent Electric timer, Standard Electric Time Co., Type S-10 or equivalent Multimeter, Simpson Model 260 or equivalent

Gun Sight Mk 31

Test or Operation	Equipment Required
Air gap centering and magnet centering	SA 2312203 SA 2312205 (Mods 1 and 2 only) SA 2312206 SA 2312210 Electric timer, Standard Electric Time Co., Type S-10 or equivalent
Assembly of gun sight	SA 2312213
Caging device zeroing	SA 2312206 SA 2312210
Calibration scale	SA 2312203 SA 2312205 (Mods 1 and 2 only) SA 2312206 SA 2312210
Compensating cam and magnet alignment	SA 2312203 SA 2312205 (Mods 1 and 2 only) SA 2312206 SA 2312210
Electrical connection and calibration unit	Insulation tester, 500 volts DC Five-place resistance bridge L&N Cat. No. 4725
Final assembly and collimation	SA 2311454 SA 2312214
Final readings	SA 2312206 SA 2312210
Friction test	SA 2312203 SA 2312205 (Mods 1 and 2 only) SA 2312206 SA 2312210 Electric timer, Standard Electric Time Co., Type S-10 or equivalent
Gimbal frame centering	SA 2312212

Test or Operation	Equipment Required
Gyro rotation and motor current...	SA 2312210
Gyro spin axis centering..........	SA 2311451 Dial indicator Sponge rubber wedge and block
Illumination circuit check........	SA 2312210
Mirror frame pivot end play.......	SA 2311451 Dial indicator
Mirror unit balance...............	SA 2311452
Nutation damper...................	SA 2312203 SA 2312205 (Mods 1 and 2 only) SA 2312206 SA 2312210 Electric timer, Standard Electric Time Co., Type S-10 or equivalent
Overhaul and repair...............	SA 2311541 SA 2311453 SA 2312211 SA 2312213
Pickoff polarity and null position........................	SA 2312210
Pickoff zeroing and gradient check............................	SA 2312206 SA 2312210 Phase meter, Technical Instrument Co., Type 320-A or equivalent
Range rate servo unit.............	Insulation tester, 500 volts DC Five-place resistance bridge L&N Cat. No. 4725 Spring scale 0-10 ounce 1/4-inch pulley for servomotor shaft
Static balance of gyro unit.......	SA 2311453
Superelevation computer...........	SA 2312203 SA 2312205 (Mods 1 and 2 only) SA 2312206

Test or Operation	Equipment Required
Superelevation computer (continued)	SA 2312210 Electric timer, Standard Electric Time Co., Type S-10 or equivalent
Superelevation computer end play	Dial indicator
Turntable tests	SA 2312192 SA 2312203 SA 2312205 (Mods 1 and 2 only) SA 2312206 SA 2312210 SA 2312219 Electric timer, Standard Electric Time Co., Type S-10 or equivalent

Appendix B

TABULATION OF PRINCIPAL DRAWINGS AND LISTS OF DRAWINGS

Amplifier Mk 121 Drawings	Mod 1	Mod 2	Mod 3
Assembly	1311825	1473150	1473149
Control Unit	887297	887297	887297
Electrical Schematic	1182634	1182634	1182634
Wiring Diagram	1201699	1201699	1201699
Magnet Current Supply	887298	887298	887298
Capacitor Mounting Board	1413867	1413867	1413867
Electrical Schematic	1201728	1201728	1201728
Wiring Diagram	1311828	1311828	1311828
Power Supply	1312438	1312438	1312438
Capacitor Mounting Board	1586799	1586799	1586799
Electrical Schematic	1312439	1312439	1312439
Lower Shelf	1586795	1586795	1586795
Resistor Mounting Board	1586802	1586802	1586802
Upper Shelf	1244523	1244523	1244523
Wiring Diagram	1312440	1312440	1312440
Range Servo Unit	689791	689791	1473146
Electrical Schematic	887290	887290	1596572
Gear and Bearings	1400253	1400253	1400253
Gearing Diagram	887291	887291	1596571

Amplifier Mk 121 Drawings Cont.	Mod 1	Mod 2	Mod 3
Top and Bottom Plates	887266	887266	887266
Wiring Diagram	887291	887291	1596273
Resistor Pack	711485	1596560	1596564
Wiring Diagram	711487	1596561	1596564
Servo Amplifier	887296	887296	887296
Electrical Schematic	1201723	1201723	1201723
Wiring Diagram	1201609	1201609	1201609
Test Panel, Electrical Schematic	1312412	1473152	1473154
Wiring Diagram of Amplifier	1311831	1473151	1473153

Gun Sight Mk 31 Drawings	Mods 1, 2 and 3	Mods 4 and 5
Assembly	689784	2094690
Caging Device	1998234 (996422 Mod 3)	1998234
Case	689787	1998235
Desiccator Unit	1182654	2081827
Electrical Connection and Calibration Unit	887270	887270
Electrical Schematic	2094694 (887292 Mod 3)	2094694
Wiring Diagram	2094695 (689792 Mod 3)	2094695
Electrical Schematic of Gun Sight	1311826	2094696
Filter Control Unit	1413916	1413916
Shaft and Pins	1022403	1022403

Gun Sight Mk 31 Drawings Cont.	Mods 1, 2 and 3	Mods 4 and 5
Gyroscope and Linkage Unit.........	689785	2094691
Bracket and Insulator..........	1413890	1413890
Counterweight Support..........	1182630	1182630
Gyroscope, Disc, and Caging Pin............................	689789	689789
Link and Bearings..............	706493	706493
Mirror Unit....................	1182648	2169479
Nutation Damper................	887295	887295
Rotor and Stator...............	2169479	2169479
Spiral Connectors (Deflection).	887293	887293
Spiral Connectors (Sight Angle)	887294	887294
Superelevation Rack and Link...	1182638	1182638
Illumination Control...............	1182645	2093295
Magnetic Coil and Core.............	1413925	1413925
Main Cover (Rear Cover)............	2094700 (689788 Mod 3)	1998231
Range Magnet Unit (Mod 1, serial numbers 2-31 inclusive, use dwg 1400263).......	1586940	1586940
Coil............................	1413842	1413842
Range Rate Servo Unit..............	1311822	1311822
Bearing Gear...................	1413808	1413808
Clutch.........................	1413809	1413809
Diagram of Gearing.............	887277	887277
Electrical Schematic...........	2035263 (887288 Mod 3)	2035263
Frame and Plate................	1311821	1311821
Guide and Spring...............	718204	718204

Gun Sight Mk 31 Drawings Cont.	Mods 1, 2 and 3	Mods 4 and 5
Stop Mechanism	1413837	1413837
Wiring Diagram	2094693 (887289 Mod 3)	2094693
Telescope	1473085	1998240
Wiring Diagram of Gun Sight	1311827	2094697

Amplifier Mk 121 Lists of Drawings	Mod 1	Mod 2	Mod 3
Control Unit	175726	175726	175726
General Assembly	281916	175721	175722
Magnet Current Supply	175725	175725	175725
Power Supply Unit	175727	175727	175727
Range Servo Unit	175723	175723	175723
Resistor Pack	298565	298610	298611
Servo Amplifier	175724	175724	175724

Gun Sight Mk 31 Lists of Drawings	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5
Caging Device	416778	416778	298538	413889	413889
Filter Control Unit	298542	298542	298542	298542	298542
Shaft and Pins	298543	298543	298543	298543	298543
General Assembly	281915	175728	175729	413891	416787
Guide and Spring	298540	298540		298540	298540
Gyroscope and Linkage Unit	298537	298576	297537	416775	416789
Bracket and Insulator	298550	298550	298550	298550	298550
Gyroscope Disc and Caging Pin	298545	298545	298545	298545	298545
Link and Bearings	298548	298548	298548	298548	298548

Gun Sight Mk 31 Lists of Drawings Cont.	Mod 1	Mod 2	Mod 3	Mod 4	Mod 5
Mirror Unit..........	298547	298547	298547	416766	416766
Nutation Damper......	298551	298551	298551	298551	298551
Rotor and Stator.....	416786	416786	416786	416786	416786
Spiral Connectors (Sight Deflection)..	298546	298546	298546	298546	298546
Spiral Connectors (Sight Angle).......	298549	298549	298549	298549	298549
Magnetic Cam Coil and Core....................	298541	298541	298541	298541	298541
Parts Required for ORDALT 4330..............	416778	416778	---	---	---
Range Magnet Unit (Mod 1, serial numbers 2-31 inclusive, use LD 298544)..............	298573	298573	298573	298573	298573
Coil.................	298552	298552	298552	298552	298552
Range Rate Servo Unit....	298539	298574	298575	298539	416788
Guide and Pin........	298540	298540	298540	298540	298540
Telescope................	281921	281921	281921	413890	413890
Test Equipment...........	416785	416785	416785	416785	416785

Procurement List of Repair Parts for Gun Sight Mk 31 and Amplifier Mk 121............... Navord List No. R-23973

Appendix C

SCHEMATICS AND WIRING DIAGRAMS

Amplifier Mk 121

Title	Mod 1	Mod 2	Mod 3
Control Unit, Electrical Schematic....................	1182634	1182634	1182634
Control Unit, Wiring Diagram......................	1201699	1201699	1201699
Magnet Current Supply, Electrical Schematic.........	1201728	1201728	1201728
Magnet Current Supply, Wiring Diagram...............	1311828	1311828	1311828
Power Supply, Electrical Schematic....................	1312439	1312439	1312439
Power Supply, Wiring Diagram......................	1312440	1312440	1312440
Range Servo Unit, Electrical Schematic....................	**1311826**	**1311826**	**1311826**
Range Servo Unit, Wiring Diagram......................	**1311827**	**1311827**	**1311827**
Resistor Pack, Wiring Diagram.	711487	1596561	1596564
Servo Amplifier, Electrical Schematic....................	1201723	1201723	1201723
Servo Amplifier, Wiring Diagram......................	1201609	1201609	1201609
Test Panel, Electrical Schematic....................	1312412	1473152	1473154
Wiring Diagram of Amplifier....................	1311831	1473151	1473153

Gun Sight Mk 31

Title	Mods 1, 2 and 3	Mods 4 and 5
Electrical Connection and Calibration Unit, Electrical Schematic.........	2094694 (887292 Mod 3)	2094694
Electrical Connection and Calibration Unit, Wiring Diagram...............	**2094695** (689792 Mod 3)	2094695
Electrical Schematic of Gun Sight....................	2094696 (1311826 Mod 3)	2094696
Range Rate Servo, Electrical Schematic....................	2035263 (887288 Mod 3)	2035263
Range Rate Servo, Wiring Diagram......................	2094693 (887289 Mod 3)	2094693
Wiring Diagram of Gun Sight........................	(1311827 Mod 3)	2094697

BUORD. DWG NO. 1182634 CONT ON SHEET SH NO.

G. E. DWG NO. 677B229 CONT ON SHEET SH NO.

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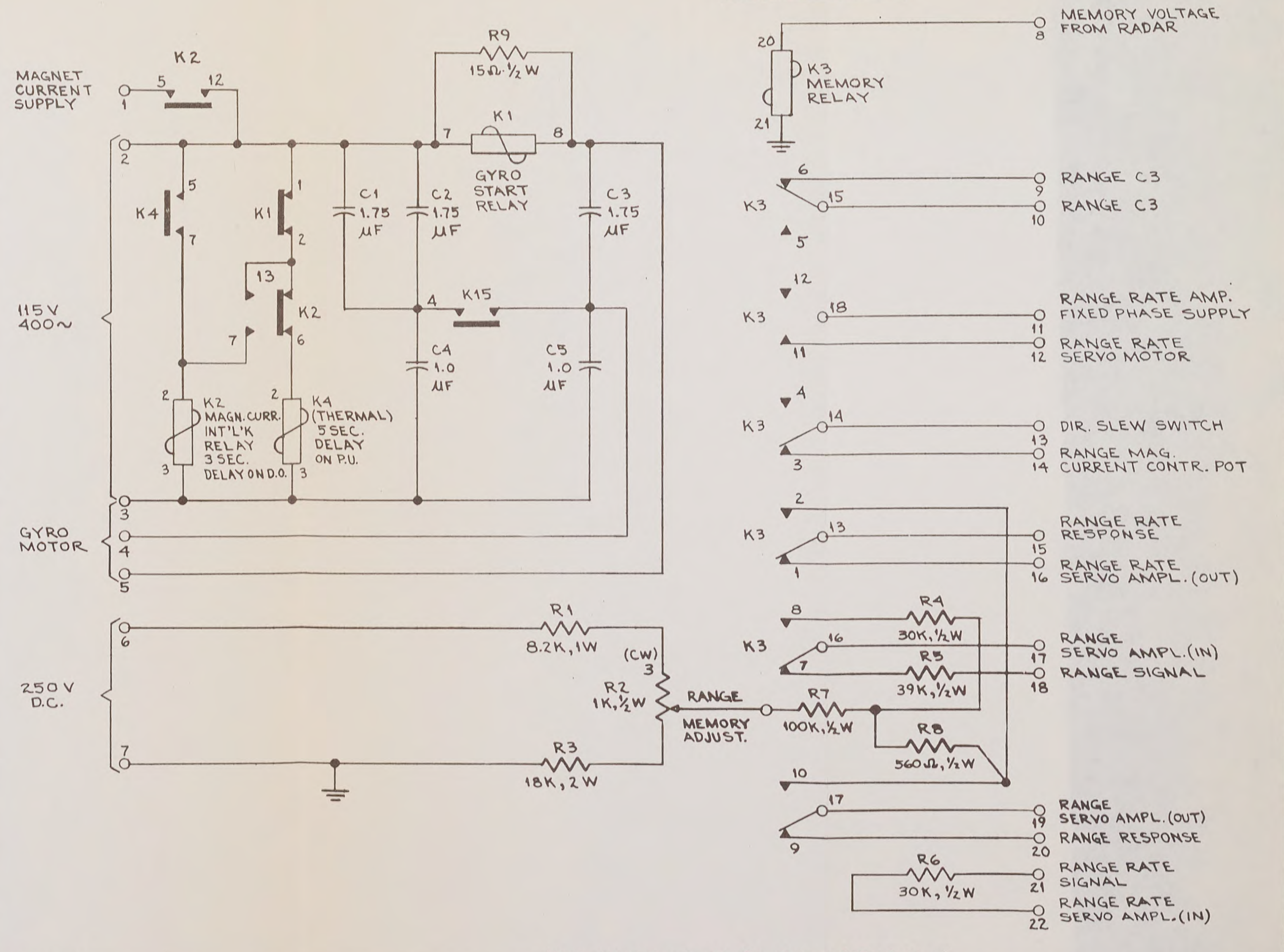
REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A	ADDED R9, SEE REV DIR	16 JUL 61	TM



F.C.F. ON G.F.C.S. MK. 70 MOD. 2 (187C896)

G. E. REVISIONS

NEXT ASSY	USED ON
887297	L.D. 175726
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON:
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

DRAWN
DATE
APPD.
ISSUED
BUORD APPROVAL
14 APR 4 1957
BY DIR CHIEF OF BUREAU

AMPLIFIER MK. 121 MOD. 1

CONTROL UNIT

SCHEMATIC - ELECTRICAL

SCALE
WT CALC ACTUAL

GENERAL ELECTRIC
M & O.S. DIV OR DEPT
PITTSFIELD LOCATION
DWG NO. 677B229
NAVY DEPT BUREAU OF ORDNANCE WASHINGTON, D.C.
BUORD. DWG NO. 1182634
CONT ON SHEET SH NO.

CODE 10001

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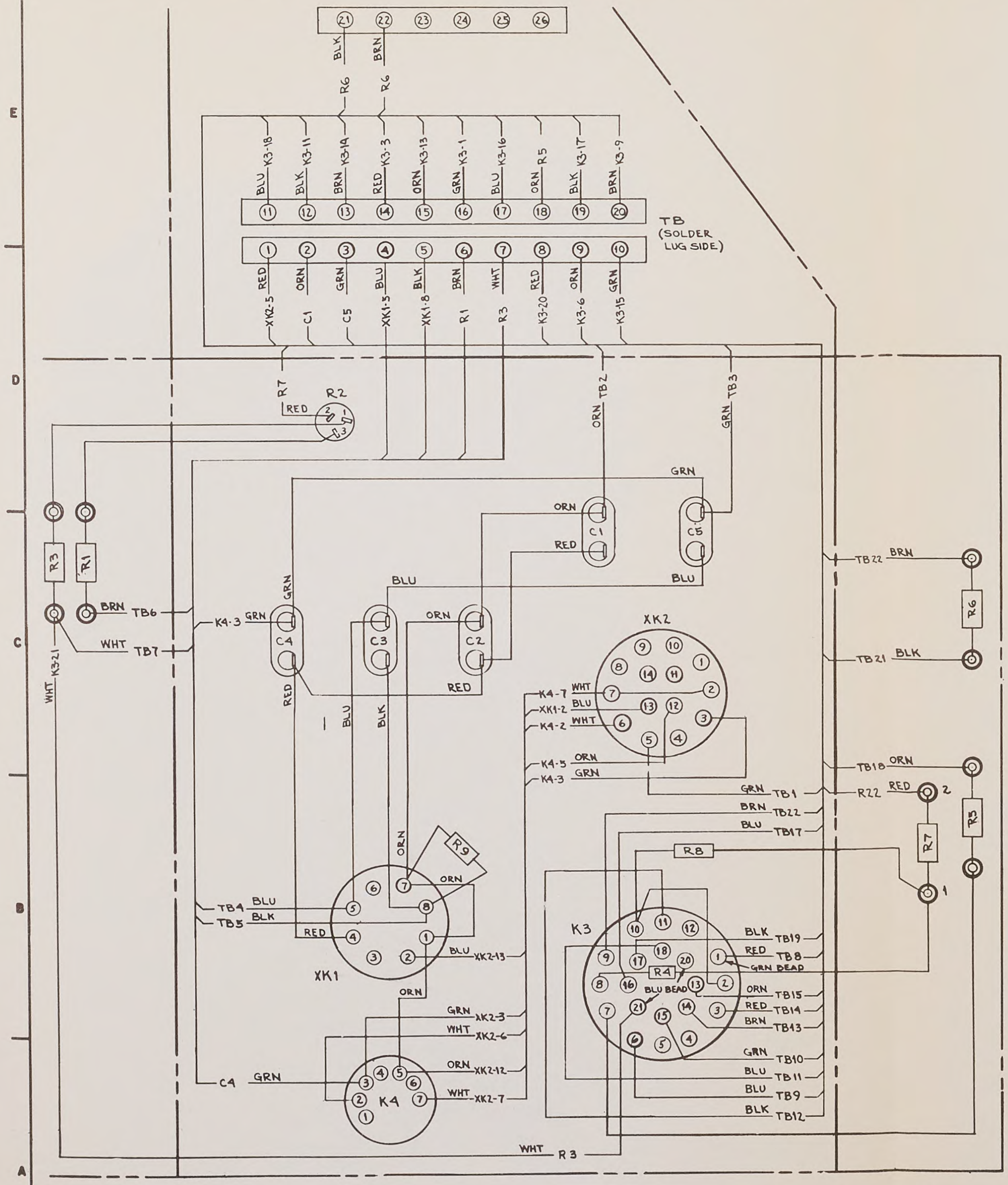
REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A 2	SEE REV DIR, ADDED R9	28 JUL 61	TM

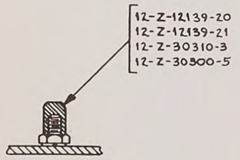


NOTES:

1. ALL WIRE TO BE MIL-W-16878 TYPE B (NYLON JACKETED). WIRE TO BE #22 AWG UNLESS OTHERWISE SPECIFIED. COLOR OF WIRE CHOSEN ARBITRARILY TO FACILITATE WIRING. (SEE TABLE).
2. SOLDER ALL CONNECTIONS USING 12-Z-37400-10
3. LACE ALL CABLES USING LACING CORD ORD. 230756P4
4. WIRING PER MIL-E-16400.

PT NO.	WIRE COLOR
4	WHT
5	BLK
6	BRN
7	RED
8	ORN
9	GRN
10	BLU

SYMBOL	ORD REFERENCE	GE PT. NO
R1	MIL RC32GF822J	2
R3	MIL RC42GF182J	3
R4	MIL RC20GF303 J	20
R6		
R5	MIL RC20GF393 J	21
R7	MIL RC20GF104 J	24
R8	MIL RC20GF561 J	25
R9	MIL RW31F150	



SECTION THRU COMPONENT FASTENERS UNDER OR NEAR USING MATERIAL SPECIFIED WHERE APPLICABLE.

F.C.F. ON G.F.C.S. MK.70 MOD.2 (187C896)

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FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
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DRAWN
DATE
APPD.
ISSUED
BUORD APPROVAL
BY DIR CHIEF OF BUREAU

AMPLIFIER MK.121 MOD.1
CONTROL UNIT
WIRING DIAGRAM

GENERAL ELECTRIC
M.G.O.S. PITTSFIELD
DWG NO. 188C293
NAVY DEPT BUREAU OF ORDNANCE WASHINGTON, D.C.
BUORD. DWG NO. 1201699
CONT ON SHEET SH NO.
SCALE
WT

887297	LD 175726
NEXT ASSY	USED ON
APPLICATION	

CODE 10001

188C293
1201699

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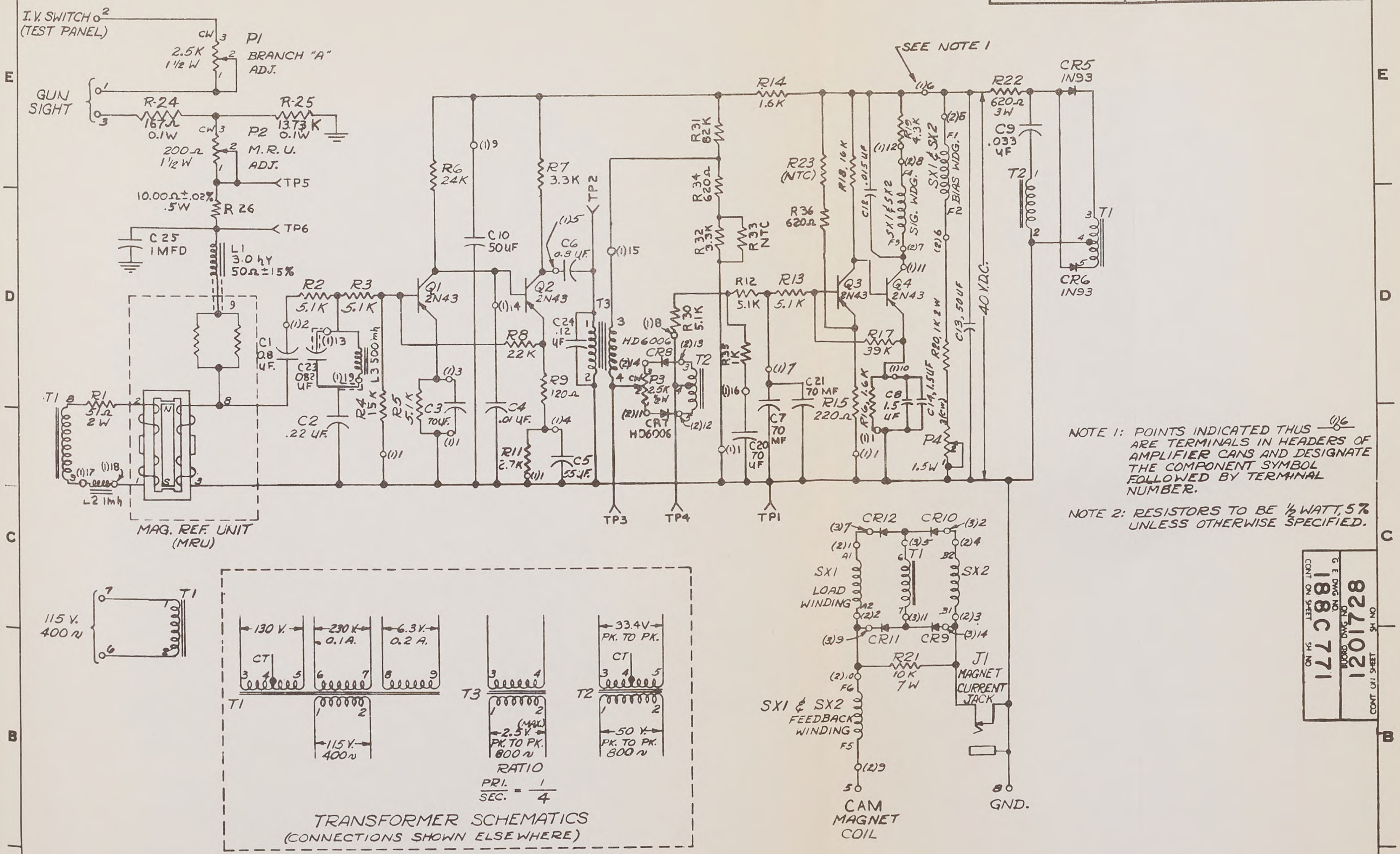
	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL



NOTE 1: POINTS INDICATED THUS (1)6 ARE TERMINALS IN HEADERS OF AMPLIFIER CANS AND DESIGNATE THE COMPONENT SYMBOL FOLLOWED BY TERMINAL NUMBER.

NOTE 2: RESISTORS TO BE ½ WATT, 5% UNLESS OTHERWISE SPECIFIED.

CONT ON SHEET	SH NO	G E DWG NO	188C771
CONT ON SHEET	SH NO	BUORD DWG NO	1201728

(187C898)
F.C.F. ON GUNFIRE CONTROL SYSTEM MK.70 MOD.2

G E REVISIONS
1
2
3
4
5 Ed Tinker ... ADDED CUSTODIAN'S APPROVAL

887298	175725
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

DRAWN
DATE
APPD.
ISSUED
BUORD APPROVAL
2 MAY 1957
BY DIR CHIEF OF BUREAU

AMPLIFIER MK.121 MOD. 1
MAGNET CURRENT SUPPLY
SCHEMATIC-ELECTRICAL

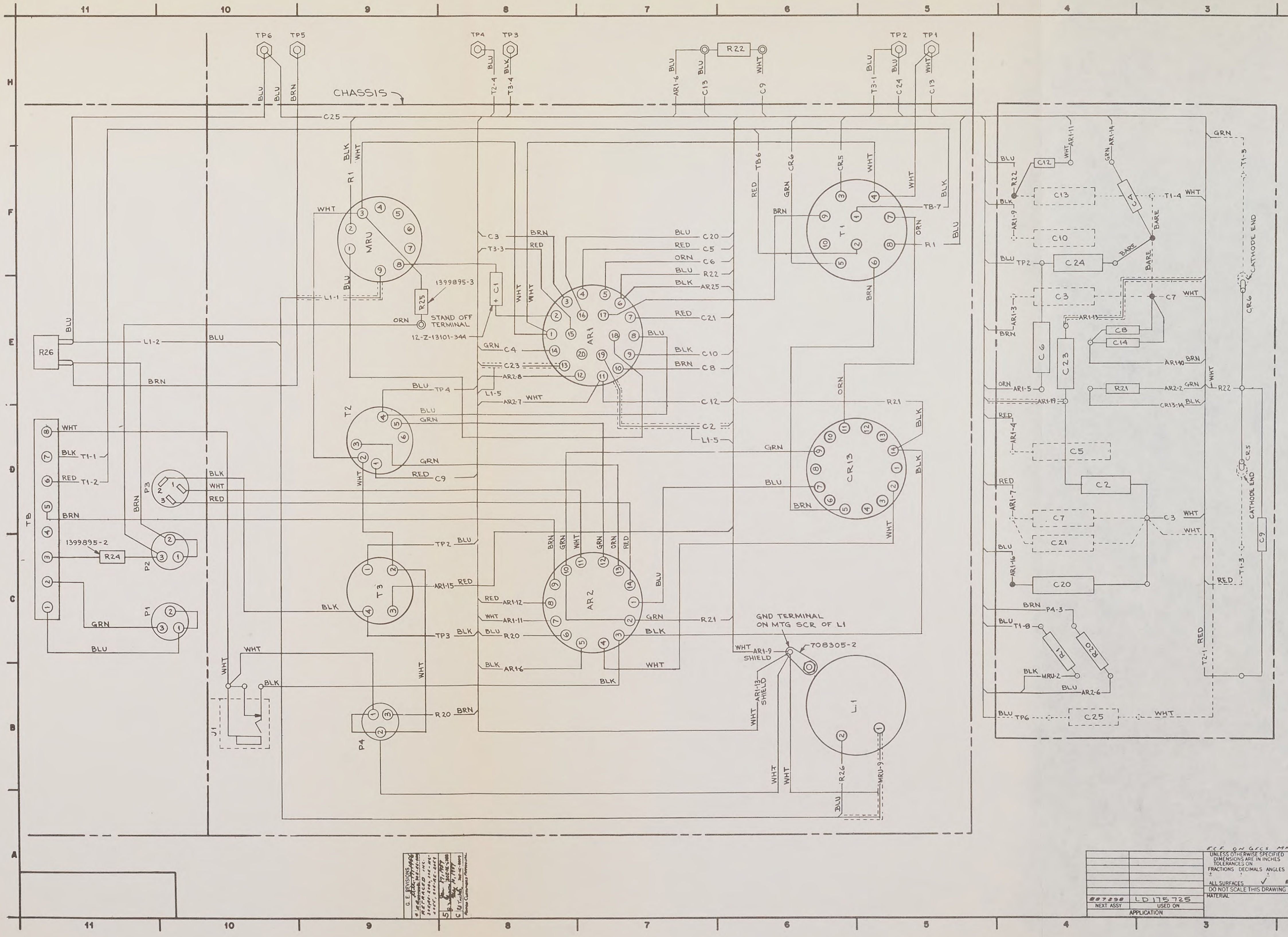
SCALE
WT CALC. ACTUAL

GENERAL ELECTRIC
M&OSD DIV OR DEPT
PITTSFIELD LOCATION
DWG NO 188C771
NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON, D.C.
BUORD. DWG NO.
1201728
CONT ON SHEET SH NO.

G. E. DWG NO.	THIS COPY FOR USE OF ONLY THE GENERAL ELECTRIC COMPANY AND SUBCONTRACTORS
168D254 CONT ON SHEET SH NO.	

REVISIONS

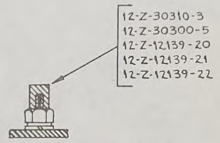
SYM	DESCRIPTION	DATE	APPROVAL
A1	SEE REV DIR	3MAY60	R.F.L.



NOTES:

1. ALL WIRE TO BE MIL-W-16878 TYPE B (NYLON JACKETED). WIRE TO BE #22AWG UNLESS OTHERWISE SPECIFIED. COLOR OF WIRE CHOSEN ARBITRARILY TO FACILITATE WIRING. (SEE TABLE)
2. SOLDER ALL CONNECTIONS USING 12-Z-37400-10
3. LACE ALL CABLES USING CORD ORD. 479894-10
4. TERMINALS DELINEATED THUS:
   - ● INDICATES A FEED THRU TURRET TERMINAL;
   - ○ INDICATES A TURRET TERMINAL THIS SIDE;
   - ◌ INDICATES A TURRET TERMINAL OPPOSITE SIDE.
5. WIRING PER MIL-E-16400.
6. Ⓐ1 USE BUS WIRE, MIL-W-3861 TY. S, SOFT COATED, .032 DIA FOR ALL JUMPER LEADS.

PT. NO.	WIRE COLOR
2	WHT
3	BLK
4	BRN
5	RED
6	ORN
7	GRN
8	BLU



SECTION THRU COMPONENT FASTENERS UNDER OR NEAR WIRE RUNS USING MATERIAL SPECIFIED WHERE APPLICABLE

BUORD DWG NO. 1311828

E.C.F. ON GFCS MK 70 MOD 2 (187C898)

887298	LD175725
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

DRAWN R FOAZEE
DATE MAR 30, 1956
APPD NDA APRIL 1956
ISSUED Apr. 19, 1956
BUORD APPROVAL 2 May 1957
BY DIR CHIEF OF BUREAU

AMPLIFIER MK 121 MOD 1

MAGNET CURRENT SUPPLY WIRING DIAGRAM

SCALE
WT CALC ACTUAL

GENERAL ELECTRIC
M&OSD PITTSFIELD
DIV OR DEPT LOCATION
DWG NO. 168D254
NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON, D.C.
BUORD. DWG NO. 1311828
CONT ON SHEET SH NO.

CODE IDENT 10001

	SYM	DESCRIPTION	DATE	APPROVAL
	A	SEE REV DIR	12APR60	R.F.S.
F-3	B	SEE REV DIR	3MAY60	R.F.S.
F4	C1	SEE REV DIR	9NOV60	J.E.B
D-4	D3	SEE REV DIR	18JUL61	TM

G.E. DWG NO 168D149 CONT ON SHEET — SH NO. 1

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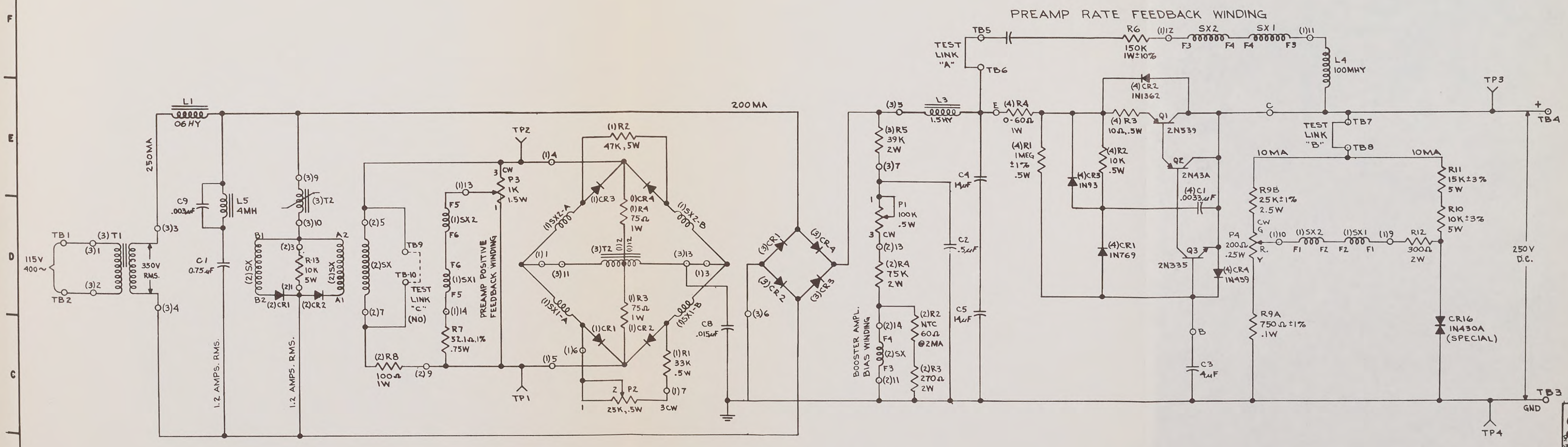


LEGEND OF
COMPONENT SYMBOLS

SYM	COMPONENT NO.	COMP. NAME
(1)	AR1	PREAMPLIFIER
(2)	AR2	BOOSTER AMPLIFIER
(3)	AR3	TRANSFORMERS & RECTIFIER
(4)	F1	FILTER

NOTES:

1.- ALL RESISTORS ±5% UNLESS OTHERWISE INDICATED.

2.- ALL WINDINGS HAVING SAME "SX" NUMBER WOUND ON SAME CORE.

3.- NUMBERS WHICH PREFIX COMPONENT SYMBOLS [FOR EXAMPLE; (2)R8] INDICATE LOCATION OF COMPONENT IN SUBASSEMBLY AS INDICATED BY TABLE.

FCF ON G.F.C.S. MK:70 MOD 2 166D148

NEXT ASSY	USED ON
1312438	L.D. 175727

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

DRAWN R. Martinelli
DATE June 13, 1956
APPD July 5, 1956
ISSUED July 11, 1956
BUORD APPROVAL 6 May 1957
C. J. Fuchs
For: SNM Seavey
BY DIR CHIEF OF BUREAU

AMPLIFIER MK:121 MOD.1
POWER SUPPLY
(SCHEMATIC-ELECTRICAL)

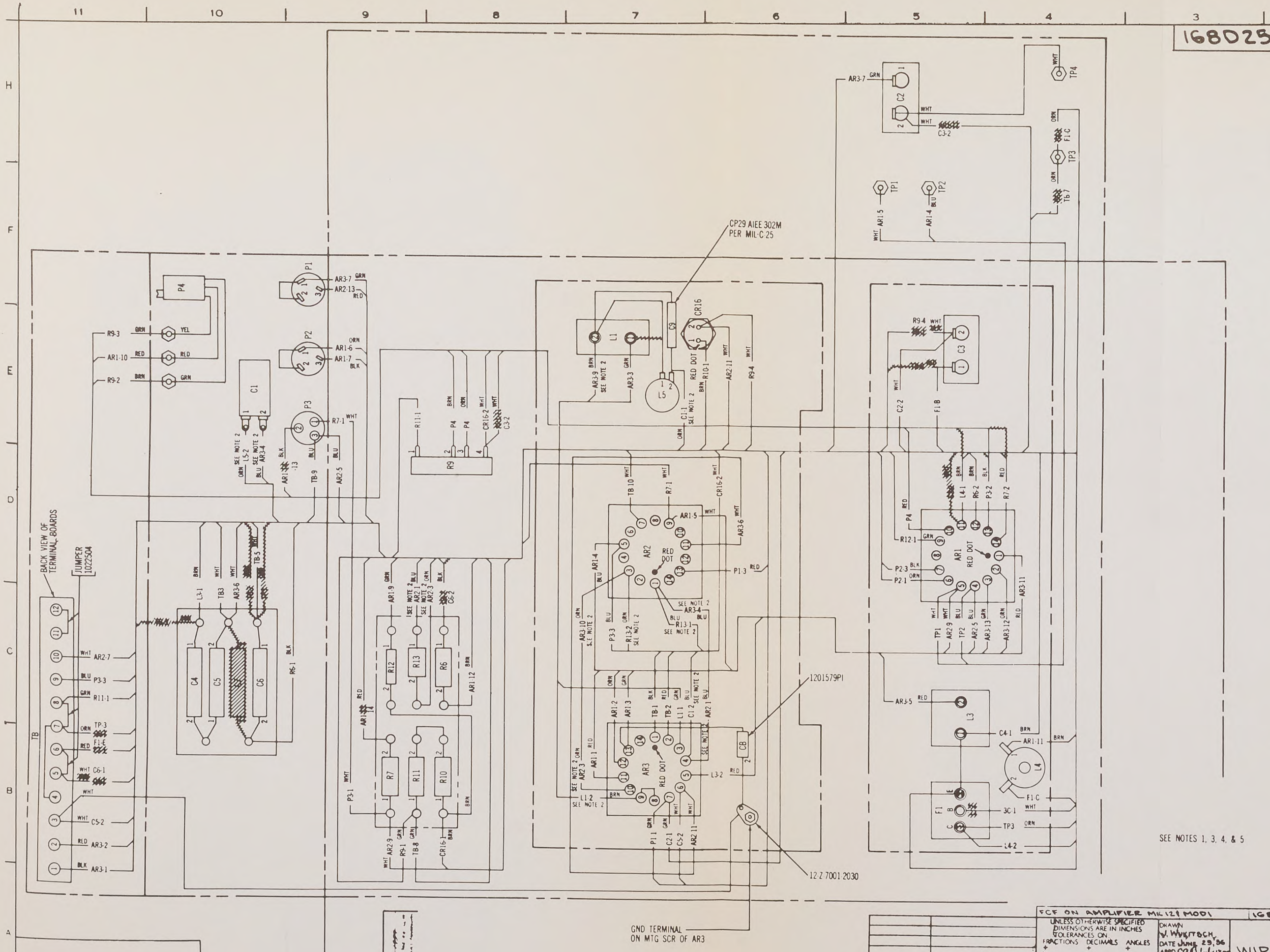
SCALE
WT CALC ACTUAL

GENERAL ELECTRIC
MEOSD PITTSFIELD
DIV OR DEPT LOCATION
DWG NO 168D149
NAVY DEPT BUREAU OF ORDNANCE WASHINGTON, D.C.
BUORD DWG NO.
1312439
CONT ON SHEET — SH NO. 1
CODE IDENT 10001

1312439

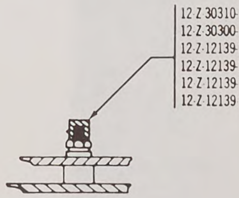
1680258

ZONE				
	A	SEE REV DIR	4 MAR 60	
B4	B1	AR1-11 WAS AR1- SEE R.D.	19 JUL 61	



NOTES:
1. ALL WIRES TO BE MIL-16878 TYPE B (NYLON JACKETED). WIRE TO BE #22 AWG. UNLESS OTHERWISE SPECIFIED. COLOR OF WIRE CHOSEN ARBITRARILY TO FACILITATE WIRING (SEE TABLE)
2. THESE WIRES TO BE MIL 16878 TYPE B (NYLON JACKETED). WIRE TO BE #20 AWG.
3. SOLDER ALL CONNECTIONS USING 12-Z-37400-10
4. LACE ALL CABLES USING CORD, ORD. 479894-10
5. WIRING METHOD PER MIL-E-16400

PT NO.	COLOR	AWG. SIZE
2	WHT	22
3	BLK	22
4	BRN	22
5	RED	22
6	ORN	22
7	GRN	22
8	BLU	22
9	BRN	20
10	ORN	20
11	BLU	20



1312440

FCF ON AMPLIFIER MK121 MOD1 | 1680148

1312438	L.D.-175727
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

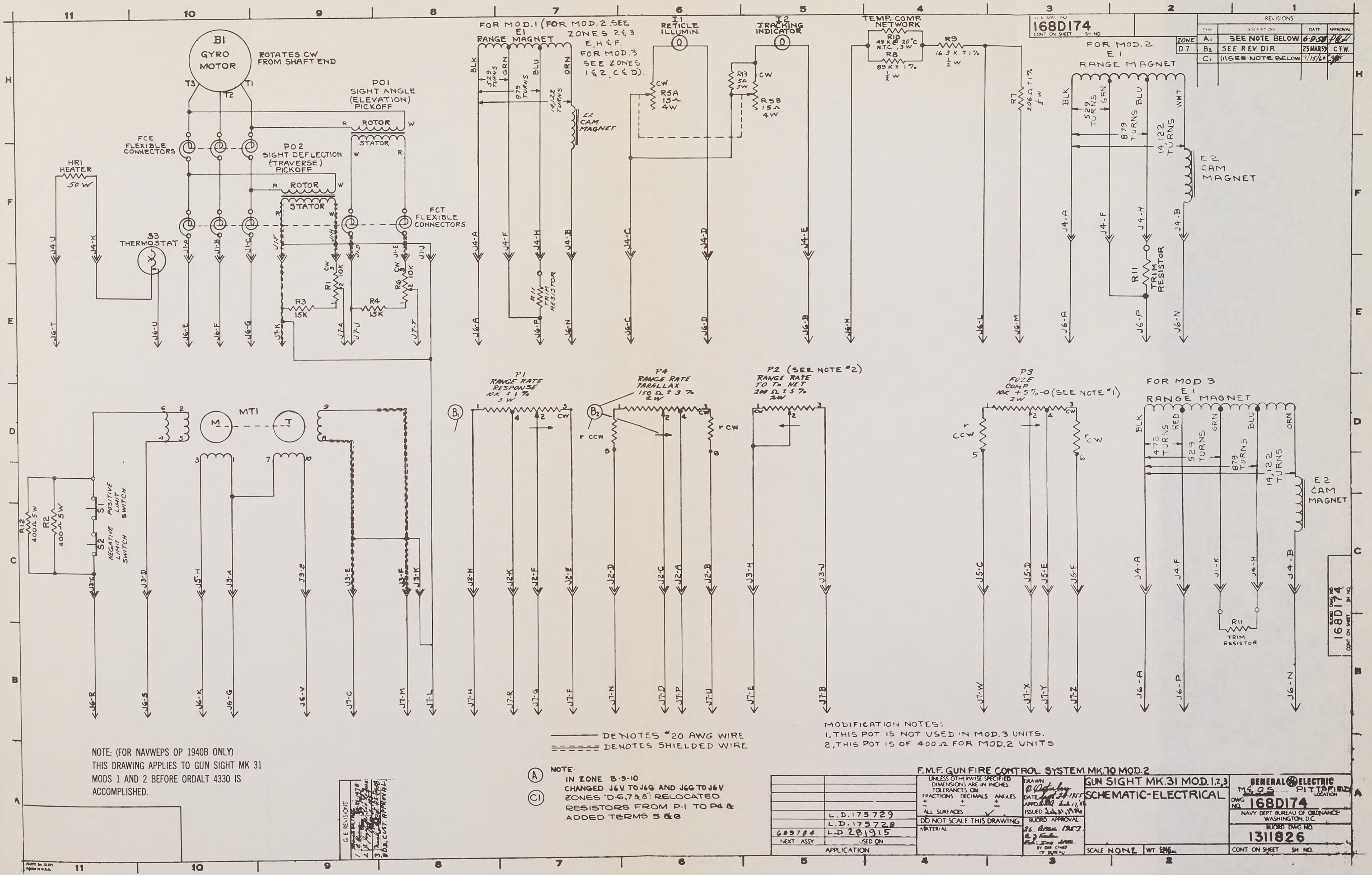
DRAWN V. WYKITSCH
DATE JUNE 29, 56
APPD C.R.W. July 1956
ISSUED July 20, 1956
BUORD APPROVAL
1 MAY 1957
R.J. Foster
For Dept. of Navy BY THE CHIEF

WIRING DIAGRAM
POWER SUPPLY
UNIT

SCALE
WT CALC ACTUAL

GENERAL ELECTRIC
MGOPD DIV OR DEPT
PITTSFIELD LOCATION
DWG NO 1680258
NAVY DEPT BUREAU OF ORDNANCE WASHINGTON DC
BUORD DWG NO
1312440
CONT. ON SHEET SH NO

CODE 10001



——— DENOTES #20 AWG WIRE
===== DENOTES SHIELDED WIRE

MODIFICATION NOTES:
1. THIS POT IS NOT USED IN MOD.3 UNITS.
2. THIS POT IS OF 400 Ω FOR MOD.2 UNITS

NOTE: (FOR NAVWEPS OP 1940B ONLY)
THIS DRAWING APPLIES TO GUN SIGHT MK 31 MODS 1 AND 2 BEFORE ORDALT 4330 IS ACCOMPLISHED.

Ⓐ NOTE:
IN ZONE B-9-10 CHANGED J6V TO J6G AND J6G TO J6V
Ⓒ1 ZONES "D-6,7 & 8": RELOCATED RESISTORS FROM P-1 TO P4 & ADDED TERMS 5 & 6

REVISIONS			
ZONE	SYM	DESCRIPTION	DATE	APPROVAL
	A1	SEE NOTE BELOW	6-9-58	
D7	B2	SEE REV DIR	25MAR59	C.F.W.
	C1	(1) SEE NOTE BELOW	7/15/60	

F.M.F. GUN FIRE CONTROL SYSTEM MK.70 MOD.2

NEXT ASSY	USED ON
	L.D.175729
	L.D.175728
609784	L.D.281915

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES

ALL SURFACES

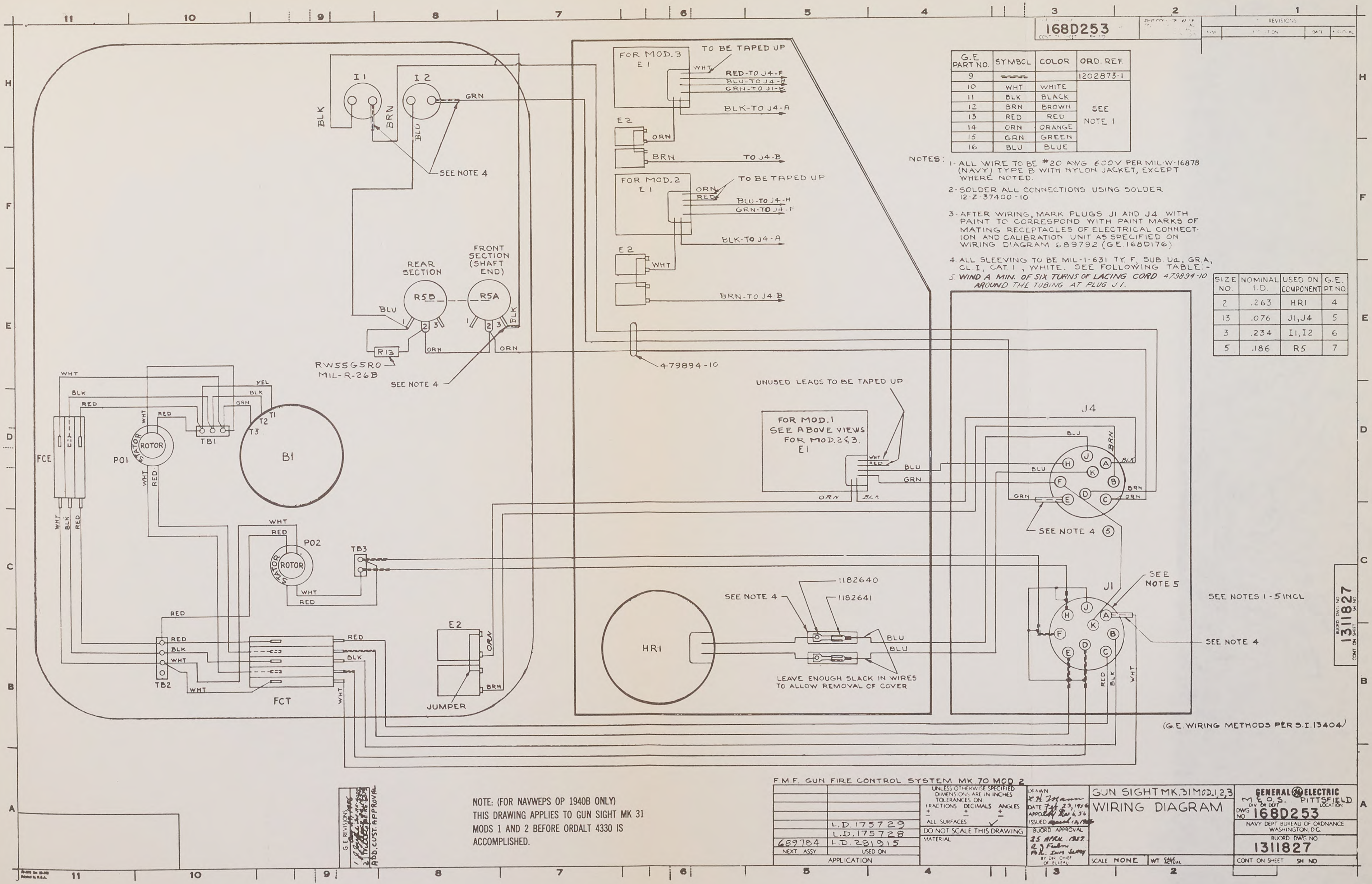
DO NOT SCALE THIS DRAWING

MATERIAL

DRAWN
DATE
APPD.
ISSUED
BUORD APPROVAL
26 APRIL 1957

GUN SIGHT MK.31 MOD.1,2,3
SCHEMATIC-ELECTRICAL

GENERAL ELECTRIC
M & O S PITTSFIELD
DWG NO. 168D174
NAVY DEPT BUREAU OF ORDNANCE WASHINGTON, D.C.
BUORD DWG NO. 1311826
SCALE NONE
CONT ON SHEET SH NO.



G.E PART NO.	SYMBOL	COLOR	ORD. REF
9	═══		1202873-1
10	WHT	WHITE	SEE NOTE 1
11	BLK	BLACK	
12	BRN	BROWN	
13	RED	RED	
14	ORN	ORANGE	
15	GRN	GREEN	
16	BLU	BLUE	

NOTES:

1- ALL WIRE TO BE #20 AWG 600V PER MIL-W-16878 (NAVY) TYPE B WITH NYLON JACKET, EXCEPT WHERE NOTED.

2- SOLDER ALL CONNECTIONS USING SOLDER 12-Z-37400-10

3- AFTER WIRING, MARK PLUGS J1 AND J4 WITH PAINT TO CORRESPOND WITH PAINT MARKS OF MATING RECEPTACLES OF ELECTRICAL CONNECTION AND CALIBRATION UNIT AS SPECIFIED ON WIRING DIAGRAM 689792 (G.E. 168D176)

4. ALL SLEEVING TO BE MIL-I-631 TY. F, SUB. Ua, GR. A, CL. I, CAT. I, WHITE. SEE FOLLOWING TABLE:-

5. WIND A MIN. OF SIX TURNS OF LACING CORD 479894-10 AROUND THE TUBING AT PLUG J1.

SIZE NO.	NOMINAL I.D.	USED ON COMPONENT	G.E. PT. NO
2	.263	HR1	4
13	.076	J1, J4	5
3	.234	I1, I2	6
5	.186	R5	7

NOTE: (FOR NAVWEPS OP 1940B ONLY)
THIS DRAWING APPLIES TO GUN SIGHT MK 31
MODS 1 AND 2 BEFORE ORDALT 4330 IS
ACCOMPLISHED.

F.M.F. GUN FIRE CONTROL SYSTEM MK 70 MOD 2

	L.D. 175729
	L.D. 175728
689784	L.D. 281915
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

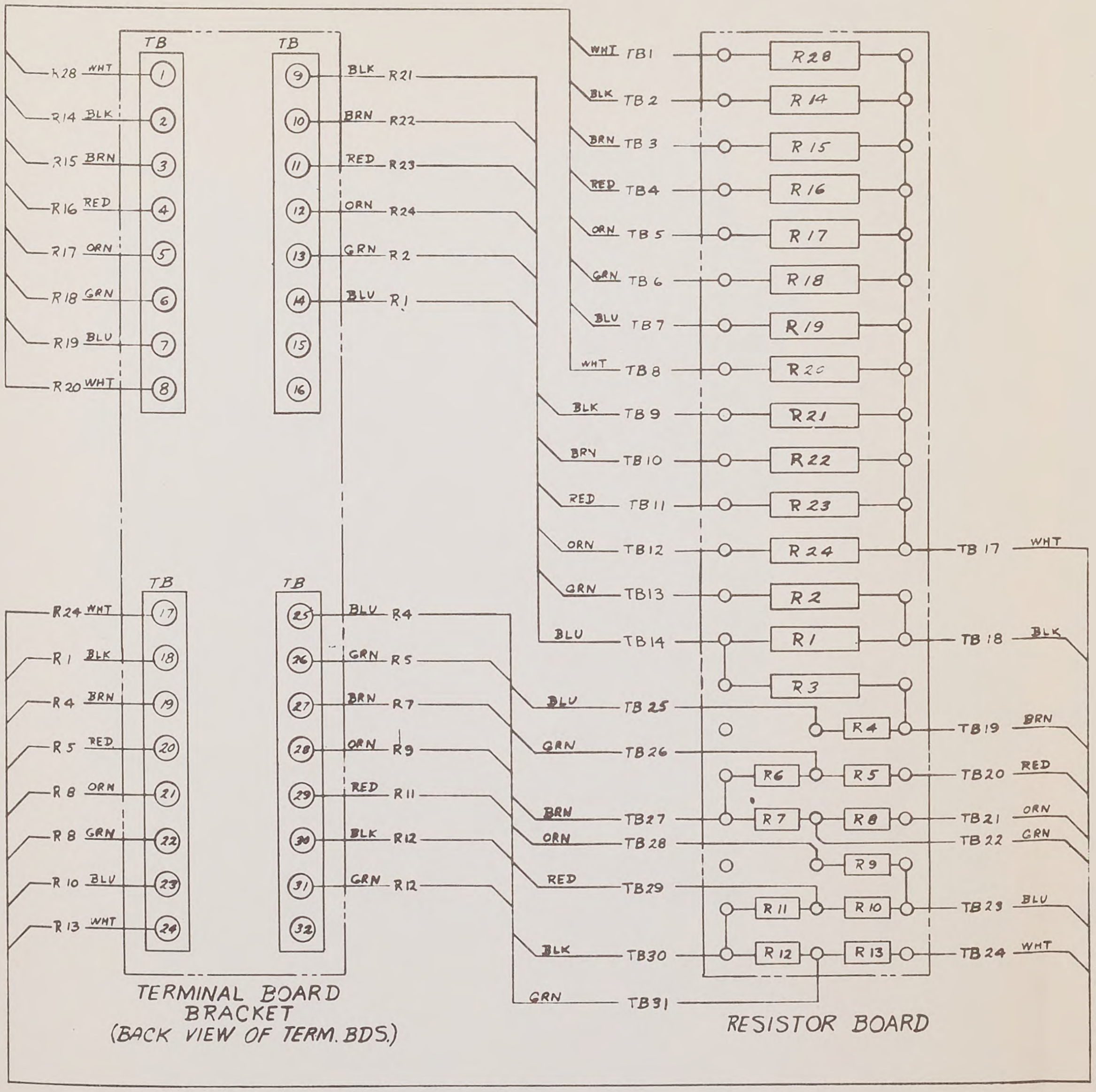
DRAWN K H Mann
DATE Feb 23, 1956
APPD Mar 6, 56
ISSUED March 12, 1956
BUORD APPROVAL
25 APRIL 1957
FOR: Insm Survey
BY DIR. CHIEF OF BUREAU

GUN SIGHT MK. 31 MOD. 1,2,3
WIRING DIAGRAM
SCALE NONE
WT CALC ACTUAL

GENERAL ELECTRIC
M & O.S. PITTSFIELD
DIV OR DEPT LOCATION
DWG NO 168D253
NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON, D.C.
BUORD DWG NO
1311827
CONT ON SHEET SH NO

THIS COPY FOR USE OF ONLY THE GENERAL ELECTRIC COMPANY AND SUBCONTRACTORS

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A2	SEE REV DIR	3MAY60	R.F.S.



NOTES:

1: ALL WIRE TO BE MIL-W-16878 TYPE B (NYLON JACKETED). WIRE TO BE #22 AWG, UNLESS OTHERWISE SPECIFIED COLOR OF WIRE CHOSEN ARBITRARILY TO FACILITATE WIRING (SEE TABLE)
2: SOLDER ALL CONNECTIONS USING 12-Z-37400-10
3: LACE CABLES USING CORD ORD. 83,230756-4
4. USE BUS WIRE PER MIL-W-3861 TY. S, SOFT COATED .032 DIA FOR ALL JUMPER LEADS.
5. WIRING PER MIL-E-16400.

PC. NO.	WIRE COLOR
2	WHT
3	BLK
4	BRN
5	RED
6	ORN
7	GRN
8	BLU

G.E. DWG NO. 188C790
CONT ON SHEET SH NO.
BUORD. DWG NO. 711487
CONT ON SHEET SH NO.

SEE NOTES 1,2,3,4 & 5

(G.E. WIRING METHODS PER S.I. 13404)

G. E. REVISIONS
1 R. Russell
2 [illegible] 1,1957
ADDED CUSTOMER'S APPROVAL

PF-774 900 12-56
PRINTED IN U.S.A.

711485	L.D. 298565
NEXT ASSY	USED ON
APPLICATION	

F.C.F. ON AMPLIFIER MK. 121 MOD. 1 (188C788)

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

DRAWN Clarke W Barnes
DATE April 2, 1956
APPD April 2, 56
ISSUED April 4, 1956
BUORD APPROVAL
18 APRIL 1957
[illegible]
[illegible]
BY DIR CHIEF OF BUREAU

RESISTOR PACK WIRING DIAGRAM

SCALE —
WT CALC ACTUAL

GENERAL ELECTRIC
M & OSD PITTSFIELD
DIV OR DEPT LOCATION
DWG NO. 188C790
NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON, D.C.
BUORD. DWG NO. 711487
CONT ON SHEET SH NO.
CODE IDENT 10001

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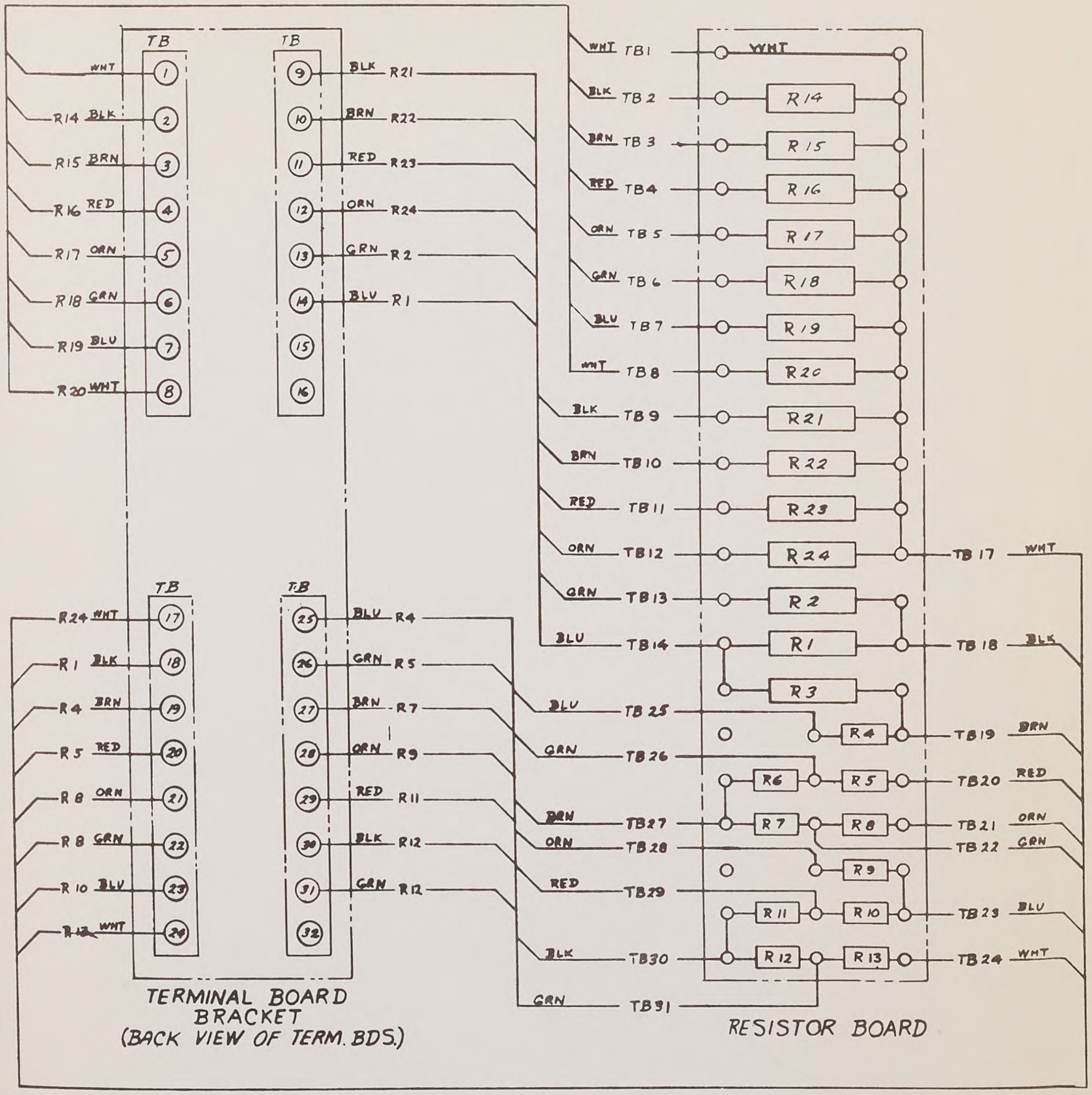
REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A1	SEE REV DIR	3MAY60	R.F.S.



NOTES

1: ALL WIRE TO BE MIL-W-16878 TYPE B (NYLON JACKETED) WIRE TO BE #22 AWG, UNLESS OTHERWISE SPECIFIED COLOR OF WIRE CHOSEN ARBITRARILY TO FACILITATE WIRING (SEE TABLE)

2: SOLDER ALL CONNECTIONS USING 12-Z-37400-10

3: LACE CABLES USING CORD, ORD. 83,230756-4

(A1) 4. USE BUS WIRE MIL-W-3861 TYS, SOFT, COATED, .032 DIA FOR ALL JUMPER LEADS.

5. WIRING PER MIL-E-16400.

PC. NO.	WIRE COLOR
2	WHT
3	BLK
4	BRN
5	RED
6	ORN
7	GRN
8	BLU

SEE NOTES 1,2,3,4 & 5

GE WIRING METHODS PER S.I 13404

G.E. DWG NO 644C321 CONT ON SHEET SH NO
BUORD DWG NO 1596561 CONT ON SHEET SH NO

F.C.F ON AMPLIFIER MK. 121 MOD. 2 (644C320)

1596560	L.D. 298610
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

DRAWN Edith E. Stradlin
DATE MAR 19 1957
APPD CCB 4/11/57
ISSUED May 14 1957
BUORD APPROVAL
3 MAY 1957
R. J. Farber
For Dir Seaney
BY DIR CHIEF OF BUREAU

RESISTOR PACK
WIRING DIAGRAM

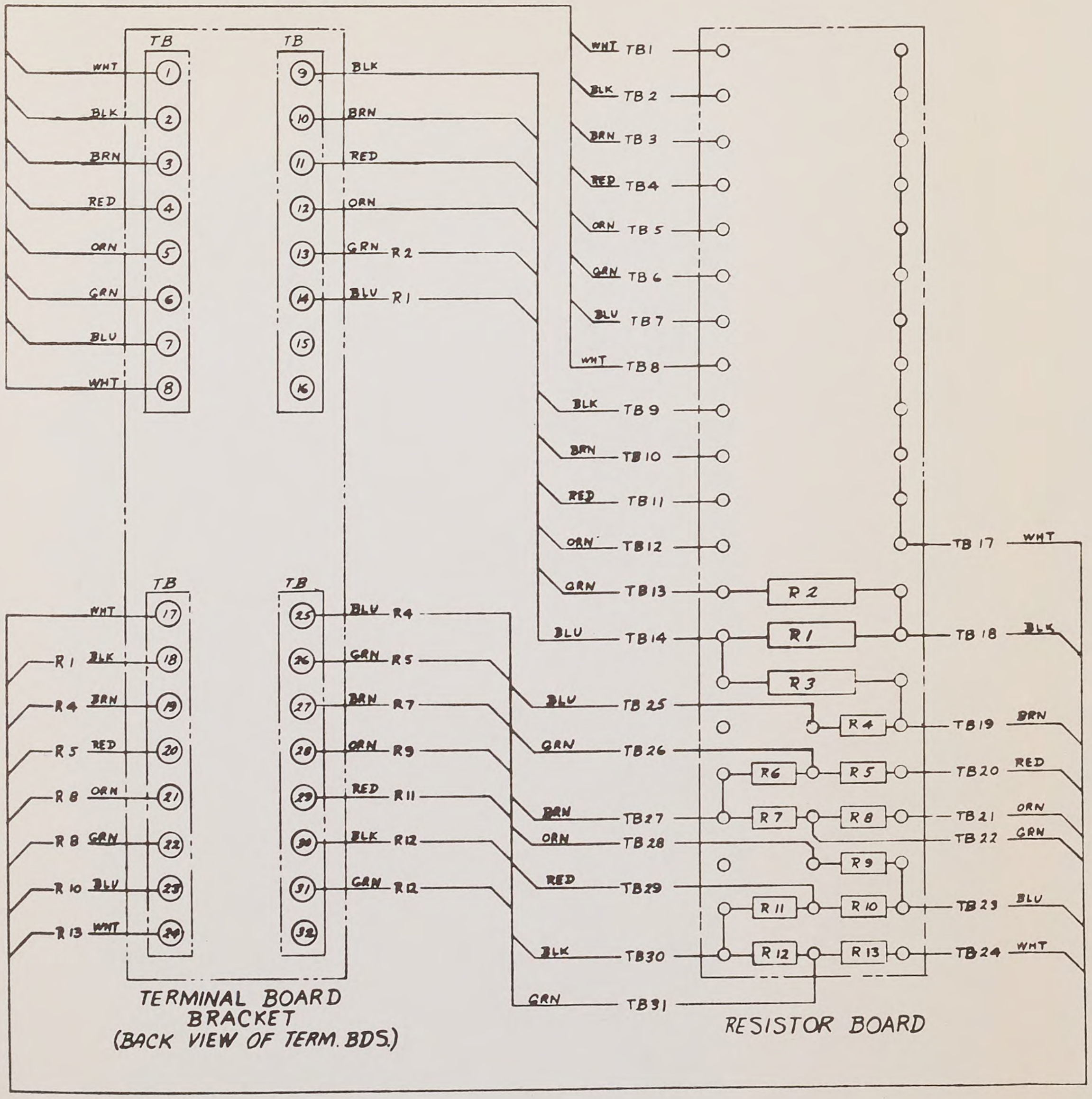
SCALE —
WT CALC ACTUAL

GENERAL ELECTRIC
M7050 DIV OR DEPT
PITTSFIELD LOCATION
DWG NO. 644C321
NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON, D.C.
BUORD DWG NO.
1596561
CONT ON SHEET SH NO.
CODE IDENT 10001

G.E. REVISIONS

THIS COPY FOR USE OF ONLY THE GENERAL ELECTRIC COMPANY AND SUBCONTRACTORS

REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL
A1	SEE REV DIA	3MAY60	R.F.S.



NOTES

1: ALL WIRE TO BE MIL-W-16878 TYPE B (NYLON JACKETED) WIRE TO BE #22 AWG, UNLESS OTHERWISE SPECIFIED COLOR OF WIRE CHOSEN ARBITRARILY TO FACILITATE WIRING (SEE TABLE)

2: SOLDER ALL CONNECTIONS USING 12-Z-37400-10

3: LACE CABLES USING CORD ORD. 83,230756-4

(A1) 4. USE BUS WIRE MIL-W-3861 TY. S SOFT, COATED, .032 DIA FOR ALL JUMPER LEADS

5. WIRING PER MIL-E-16400.

PC. NO.	WIRE COLOR
2	WHT
3	BLK
4	BRN
5	RED
6	ORN
7	GRN
8	BLU

SEE NOTES 1,2,3,4 & 5

GE WIRING METHODS PER S.I. 13404

DWG NO. 644C324 CONT ON SHEET SH NO.

BUORD. DWG NO. 1596564 CONT ON SHEET SH NO.

F.C.F ON AMPLIFIER MK. 121 MOD.3 (644C323)

1596563	LD298611
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON:
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

DRAWN E. Stadler
DATE MAR. 14, 1957
APPD [illegible]
ISSUED May 18, 1957
BUORD APPROVAL
[illegible]
BY DIR CHIEF OF BUREAU

RESISTOR PACK WIRING DIAGRAM

SCALE —
WT CALC ACTUAL

GENERAL ELECTRIC
M&OSD PITTSFIELD
DIV OR DEPT LOCATION
DWG NO. 644C324
NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON, D.C.
BUORD. DWG NO.
1596564
CONT ON SHEET SH NO.
CODE IDENT 10001

G. E. REVISIONS

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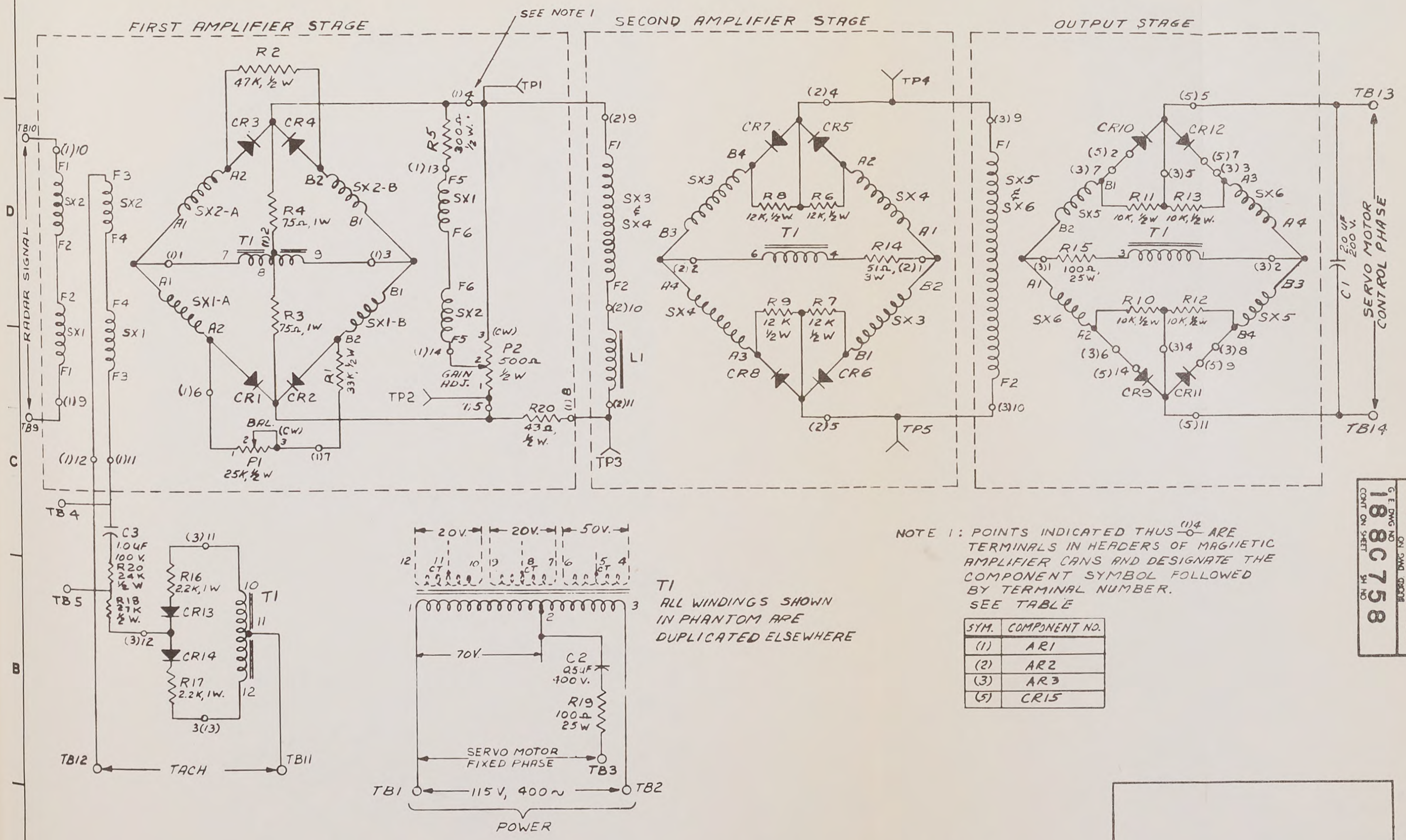
REVISIONS			
SYM	DESCRIPTION	DATE	APPROVAL



T1
ALL WINDINGS SHOWN IN PHANTOM ARE DUPLICATED ELSEWHERE

NOTE 1: POINTS INDICATED THUS —o— (1)4 ARE TERMINALS IN HEADERS OF MAGNETIC AMPLIFIER CANS AND DESIGNATE THE COMPONENT SYMBOL FOLLOWED BY TERMINAL NUMBER.
SEE TABLE

SYM.	COMPONENT NO.
(1)	AR1
(2)	AR2
(3)	AR3
(5)	CR15

CONT ON SHEET | SH NO
G E DWG NO 188C758
BUORD DWG NO 1201723
CONT ON SHEET | SH NO

FCF ON G.F.C.S. MK 70 MOD. 2 (187C 897)

887296	L.D. #175724
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

DRAWN
DATE 9-56
APPD.
ISSUED Feb. 8, 1957
BUORD APPROVAL
15 April 1957
FOR: [illegible]
BY DIR CHIEF OF BUREAU

AMPLIFIER MK.121 MOD. 1

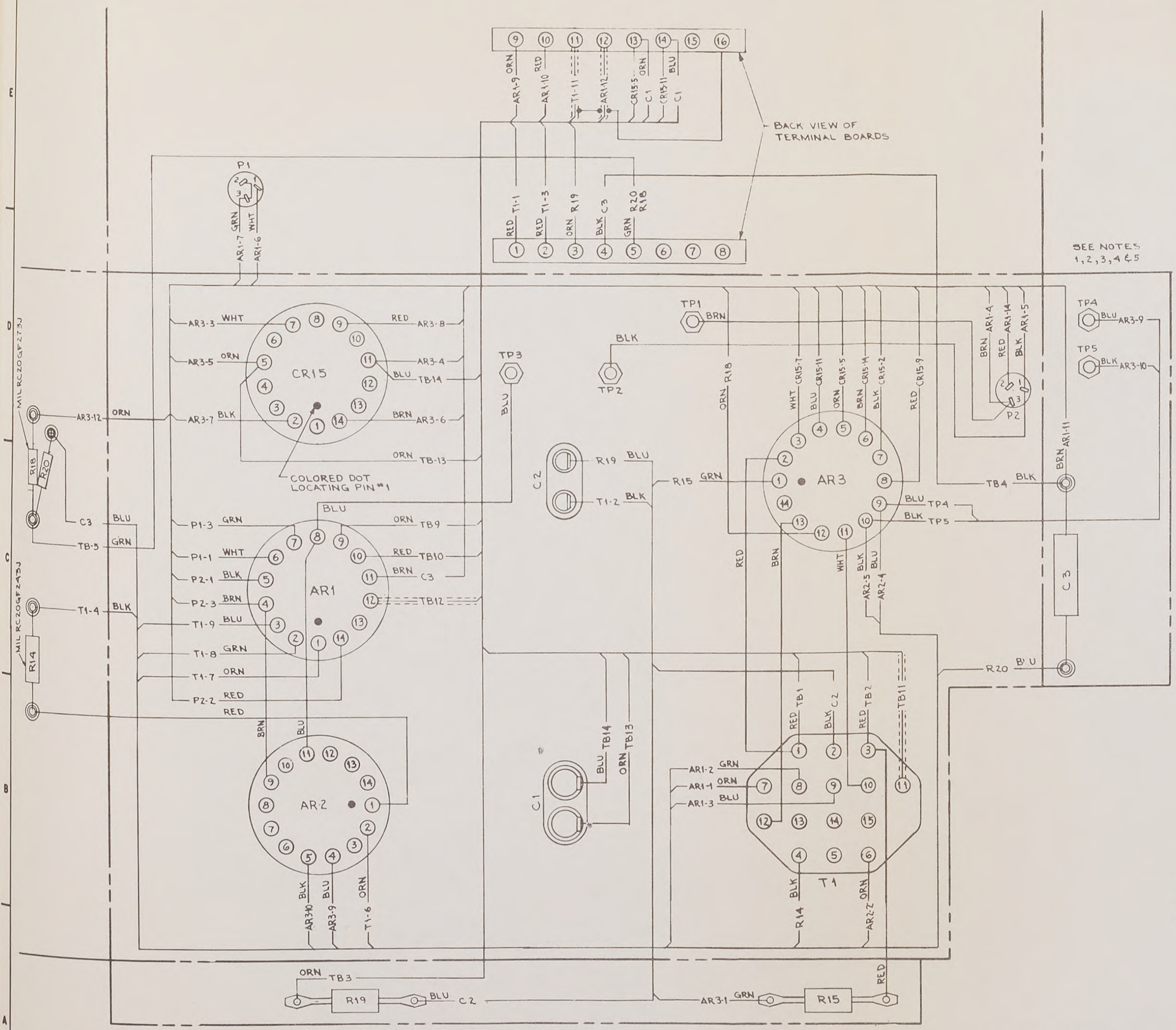
SERVO AMPLIFIER
SCHEMATIC-ELECTRICAL

SCALE | WT CALC ACTUAL

GENERAL ELECTRIC
MEOSD | PITTSFIELD
DIV OR DEPT | LOCATION
DWG NO 188C758
NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON, D.C.
BUORD. DWG NO.
1201723
CONT ON SHEET | SH NO.

G.E. REVISIONS

THIS COPY FOR USE OF ONLY THE GENERAL ELECTRIC COMPANY AND SUBCONTRACTORS	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL



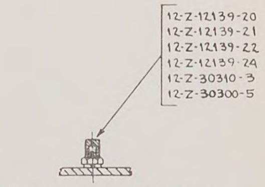
NOTES:

1. ALL WIRE TO BE MIL-W-16878 TYPE B (NYLON JACKETED). WIRE TO BE #22 AWG UNLESS OTHERWISE SPECIFIED. COLOR OF WIRE CHOSEN ARBITRARILY TO FACILITATE CIRCUIT TRACING. (SEE TABLE)
2. SOLDER ALL CONNECTIONS USING 12-Z-37400-10.
3. LACE ALL CABLES USING LACING CORD JAN-T-713, TY. 3

G.E. PT. NO.	SYMBOL	COLOR	ORD. REFERENCE
3	WHT	WHITE	SEE NOTE 1
4	BLK	BLACK	
5	BRN	BROWN	
6	RED	RED	
7	ORN	ORANGE	
8	GRN	GREEN	
9	BLU	BLUE	
20	=======	SHIELDED	1202873-1

4. APPLY SLEEVING (MIL-I-631 TY. F, SUB. Ua, G.R.A., CL. I. CATEGORY I) AS SPECIFIED BELOW AT COMPONENTS P1, P2, AR1, AR2, AR3, CR15, R15 & R19:
   (A) FOR SINGLE WIRE CONNECTIONS USE INSULATION SLEEVING AWG SIZE 8, WHITE, CUT TO APPROX. ½" LG.
   (B) FOR DOUBLE WIRE CONNECTIONS AND AT R15 & R19 USE INSULATION SLEEVING AWG SIZE 11, WHITE, CUT TO APPROX. ½" LG.
5. WIRING PER MIL-E-16400.

CONT ON SHEET 188C290 SH NO 2
BUORD DWG NO 1201609
CONT ON SHEET SH NO



SECTION THRU COMPONENT FASTENERS UNDER OR NEAR WIRE RUNS USING MATERIAL SPECIFIED WHERE APPLICABLE

F.C.F. ON G.F.C.S. MK. 70 MOD. 2 (187C897)

887296	L.D. 175724
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

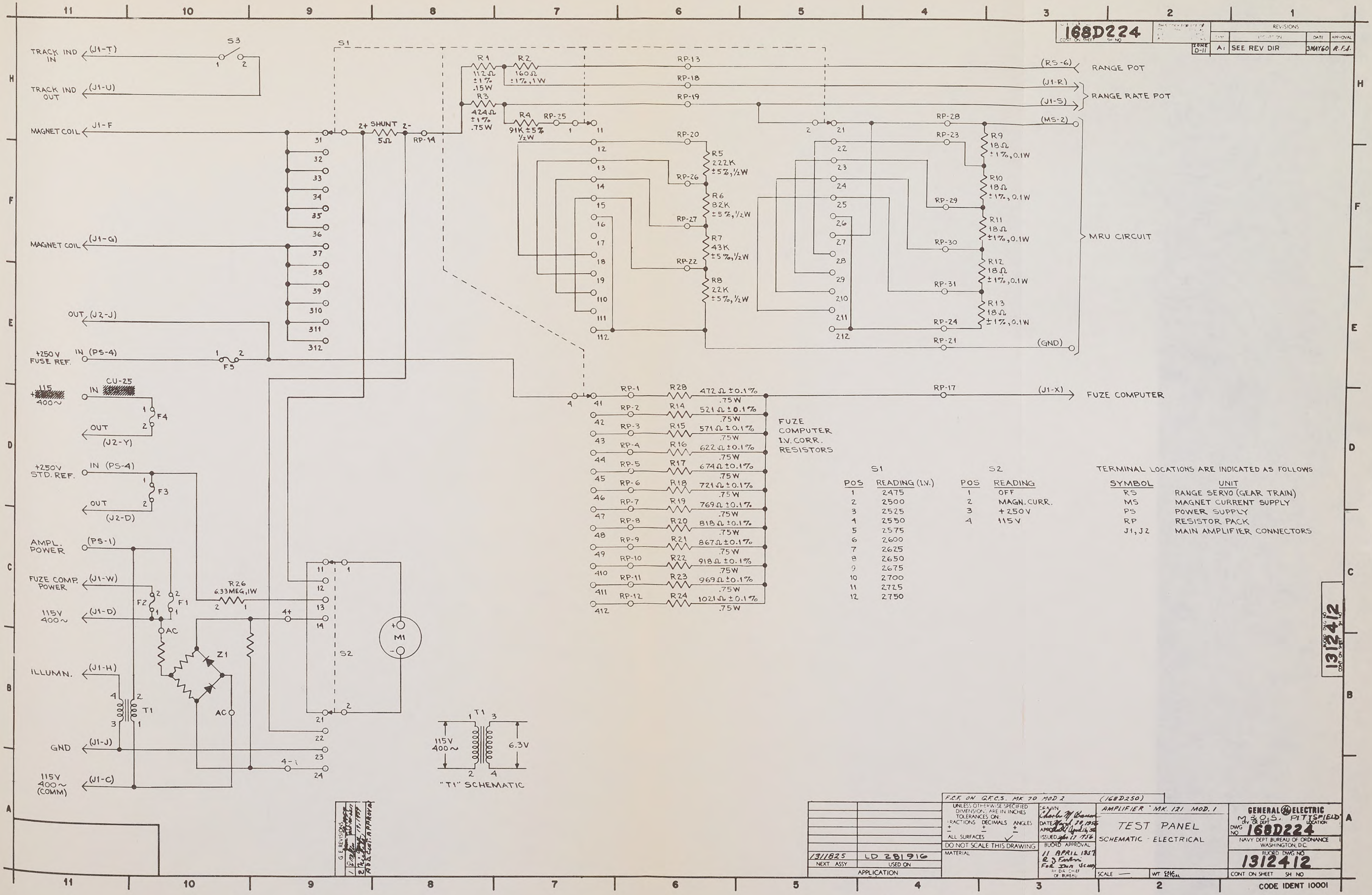
DRAWN
DATE
APPD.
ISSUED
BUORD APPROVAL
BY DIR CHIEF OF BUREAU

AMPLIFIER MK. 121 MOD. 1

SERVO AMPLIFIER
WIRING DIAGRAM

SCALE
WT

GENERAL ELECTRIC
M&CSD PITTSFIELD
DIV OR DEPT LOCATION
DWG NO 188C290
NAVY DEPT BUREAU OF ORDNANCE WASHINGTON, D.C.
BUORD. DWG NO.
1201609
CONT ON SHEET SH NO.



S1 POS	READING (I.V.)
1	2475
2	2500
3	2525
4	2550
5	2575
6	2600
7	2625
8	2650
9	2675
10	2700
11	2725
12	2750

S2 POS	READING
1	OFF
2	MAGN. CURR.
3	+250V
4	115V

TERMINAL LOCATIONS ARE INDICATED AS FOLLOWS

SYMBOL	UNIT
RS	RANGE SERVO (GEAR TRAIN)
MS	MAGNET CURRENT SUPPLY
PS	POWER SUPPLY
RP	RESISTOR PACK
J1, J2	MAIN AMPLIFIER CONNECTORS

F.C.F. ON G.F.C.S. MK 70 MOD 2 (168D250)

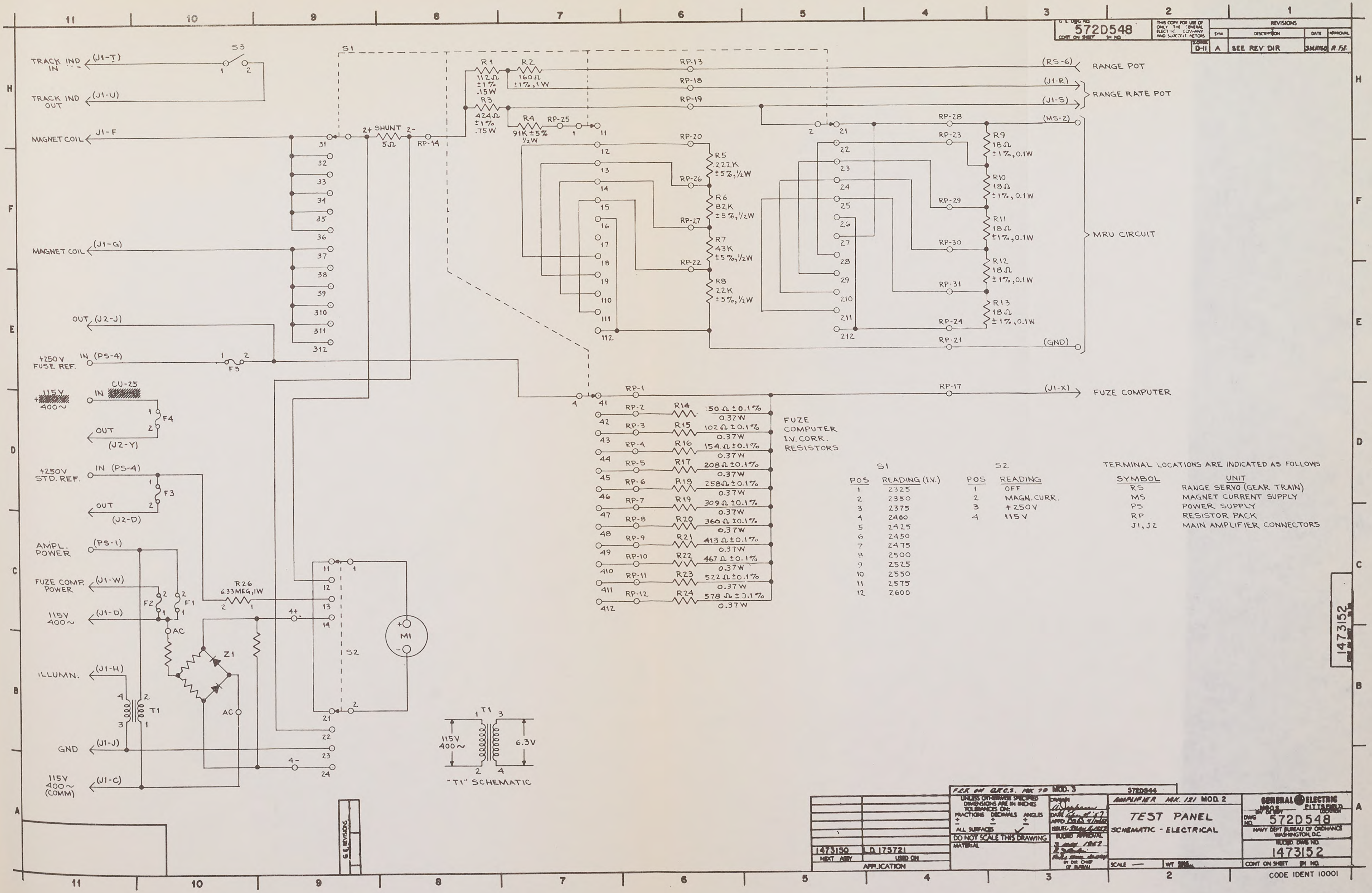
1311825 NEXT ASSY
LD 281916 USED ON
APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES ✓
DO NOT SCALE THIS DRAWING
MATERIAL

DRAWN Charles M Baum
DATE March 30, 1956
APPROVED April 16, 56
ISSUED Apr 17 1956
BUORD APPROVAL 11 APRIL 1957 R. J. Farbin For Dir Ord Sc
BY DIR. CHIEF OF BUREAU

AMPLIFIER MK. 121 MOD. 1
TEST PANEL
SCHEMATIC - ELECTRICAL
SCALE —
WT CALC ACTUAL

GENERAL ELECTRIC
M.&O.S. PITTSFIELD
DIV OR DEPT LOCATION
DWG NO 168D224
NAVY DEPT BUREAU OF ORDNANCE WASHINGTON, D.C.
BUORD DWG NO. 1312412
CONT ON SHEET SH NO
CODE IDENT 10001



S1	
POS	READING (I.V.)
1	2325
2	2350
3	2375
4	2400
5	2425
6	2450
7	2475
8	2500
9	2525
10	2550
11	2575
12	2600

S2	
POS	READING
1	OFF
2	MAGN. CURR.
3	+250V
4	115V

TERMINAL LOCATIONS ARE INDICATED AS FOLLOWS

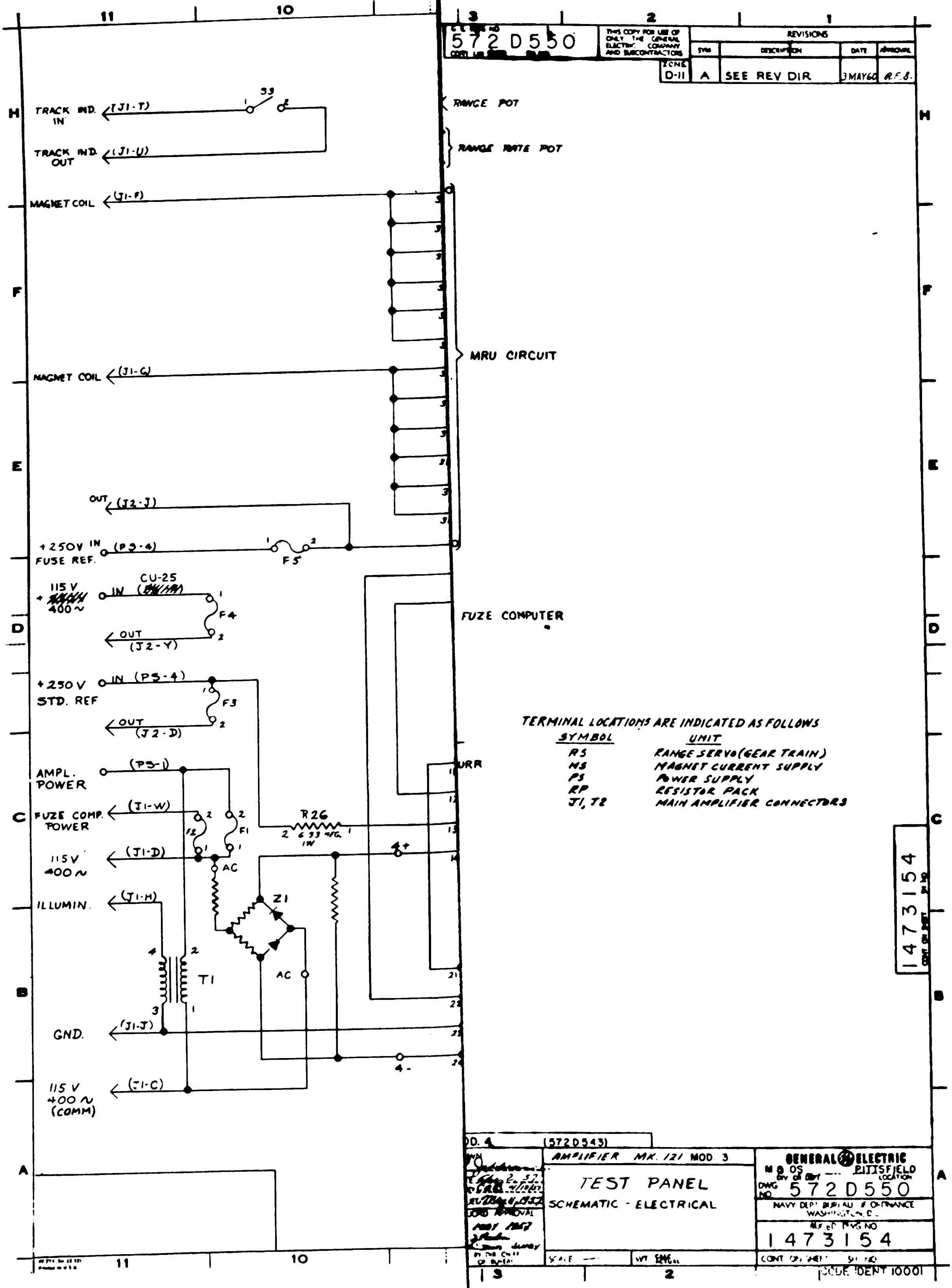
SYMBOL	UNIT
RS	RANGE SERVO (GEAR TRAIN)
MS	MAGNET CURRENT SUPPLY
PS	POWER SUPPLY
RP	RESISTOR PACK
J1, J2	MAIN AMPLIFIER CONNECTORS

G.E. DWG NO. 572D548
CONT ON SHEET SH NO.
THIS COPY FOR USE OF ONLY THE GENERAL ELECTRIC COMPANY AND SUBCONTRACTORS

REVISIONS				
ZONE	SYM	DESCRIPTION	DATE	APPROVAL
D-11	A	SEE REV DIR	3MAY60	R.F.S.

1473150	L.D. 175721
NEXT ASSY	USED ON
APPLICATION	

F.C.R. ON G.F.C.S. MK 70 MOD. 3
572D844
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS ± ANGLES ±
ALL SURFACES
DO NOT SCALE THIS DRAWING
MATERIAL
DRAWN
DATE
APPD
ISSUED
BUORD APPROVAL
3 MAY 1962
BY DIR CHIEF OF BUREAU
AMPLIFIER MK. 121 MOD. 2
TEST PANEL
SCHEMATIC - ELECTRICAL
SCALE —
WT
GENERAL ELECTRIC
MOOS
PITTSFIELD
DWG NO. 572D548
NAVY DEPT BUREAU OF ORDNANCE WASHINGTON, D.C.
BUORD DWG NO.
1473152
CONT ON SHEET SH NO.
CODE IDENT 10001

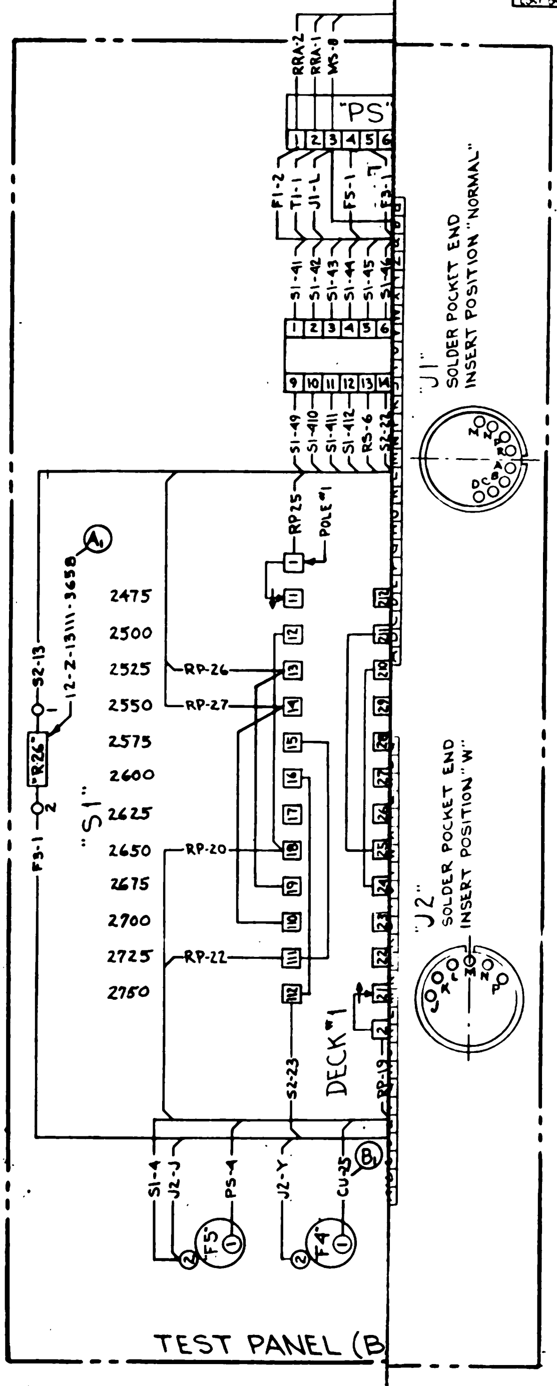


TERMINAL LOCATIONS ARE INDICATED AS FOLLOWS

SYMBOL	UNIT
RS	RANGE SERVO (GEAR TRAIN)
MS	MAGNET CURRENT SUPPLY
PS	POWER SUPPLY
RP	RESISTOR PACK
J1, J2	MAIN AMPLIFIER CONNECTORS

168D141

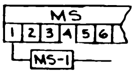
ZONE	SYM	DESCRIPTION	DATE	APPROVAL
E-11	A_1	SEE REV DIR	4-4-59	JEB
[illegible]	B_2	SEE REV DIR	6-10-58	JEB
C1-C2 B1-B2	C_4	SEE REV DIR	3MAY60	R.F.S.
D7-B2	D2	SEE REV DIR	18JUL61	TM



UNLESS OTHERWISE SPECIFIED:

NOTES:

1. ALL WIRE TO BE MIL-W-16878 TYPE B (NYLON JACKETED), BLACK, #20 AWG.
2. ALL SHIELDED WIRE (⩦) TO BE MIL-W-16878 TYPE C (NYLON JACKETED), BLACK, #22 AWG.
3. SOLDER ALL CONNECTIONS USING, 12-Z-37400-10
4. LACE ALL CABLES USING LACING CORD, JAN-T-713 TY. S COMP. P. CL. 3 (172B359P.4)
5. AT "PS", "RP", "MS", "RRA", "RA" & "CU" APPLY TERMS., 12-Z-7000-414, TO ALL TERM. POINTS INCLUDING SPARES. TERMINALS TO BE CRIMPED AND SOLDERED.
6. APPLY SLEEVING TO ALL TERMINALS (MIL-1-631 TY. F, SUB. Ua. GR. A, CL. I. CATEGORY 1) AWG. SIZE 8, 3/4 LG., WHITE SLEEVING TO BE MARKED, IN DURABLE BLACK INK, WITH TERMINAL POINT TO WHICH IT CONNECTS USING 3/32 CHARACTERS. i.e.



7. LEGEND FOR SYMBOLS (✱)

"PS"	POWER SUPPLY
"RP"	RESISTOR PACK
"MS"	MAGNET CURRENT SUPPLY
"CU"	CONTROL UNIT
"RS"	RANGE SERVO
"RRA"	RANGE RATE SERVO AMPLIFIER
"RA"	RANGE SERVO AMPLIFIER

8. ON J1 & J2 CONNECTORS USE SLEEVING, MIL-1-631 TY. F, SUB. Ua, GR. A, CL. 1, CATEGORY 1, AWG SIZE 10, 5/8 LG., WHT.
9. USE BUS WIRE, MIL-W-3861, TYPE S, SOFT, COATED (ASTM.B33) .032 DIA & SLEEVING, MIL-1-631 TY-F SUB UA GR. A CL 1, CATEGORY 1, AWG SIZE 20 BLK. ON FOLLOWING CONNECTIONS:
   S1
   12-18, 13-19, 14-110, 15-111, 16-112, 21-27, 22-28, 23-29, 24-210, 25-211, 26-212 ON S2, 11-21.
10. USE ONLY BUS WIRE MIL-W-3861, TYPE S SOFT COATED, .032 DIA. ON FOLLOWING CONNECTIONS: 31, 32, 33, 34, 35, 36, 37, 38, 39, 310, 311, 312 - AT S1.
11. ON CABLES FROM J1 & J2 CONNECTORS USE INSULATION SLEEVING, PER MIL E-5400 (174B296 P.20) & PER MIL E-5400 (174B296 P.22). 12-Z-7018-1349 & 12-Z-7018-1350 SEE NOTES 1 THRU 13
12. FOR SINGLE PHASE OPERATION: ADD JUMPER FROM CU-4 TO CU-25
13. WIRING PER MIL-E-16400

BUORD DWG NO 1311831 CONT ON SHEET SH NO

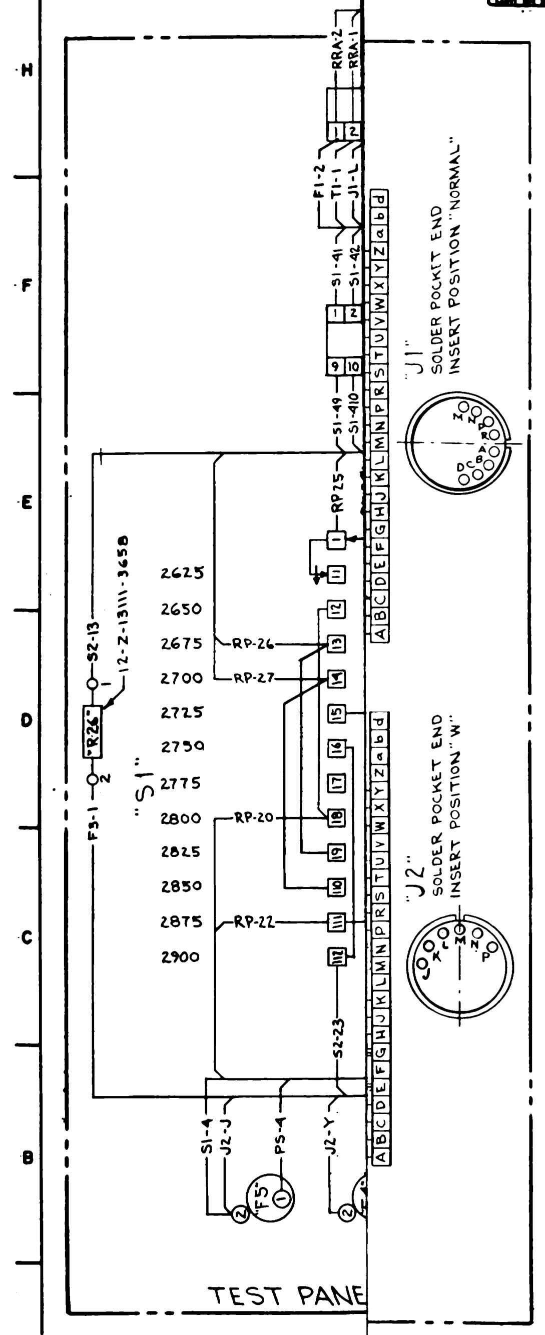
F.C.S. MK. 70 MOD. 2 (168D250)

WISE SPECIFIED ARE IN INCHES ON CIMALS ANGLES ±	DRAWN DATE [illegible] 1956 APPD [illegible] 56 ISSUED [illegible] 1956	AMPLIFIER MK.121 MOD.1 WIRING DIAGRAM	GENERAL ELECTRIC M&O S PITTSFIELD DIV OR DEPT LOCATION DWG NO 168D141
THIS DRAWING	BUORD APPROVAL 11 [illegible] 1957 [illegible] FOR: [illegible] BY DIR CHIEF OF BUREAU		NAVY DEPT BUREAU OF ORDNANCE WASHINGTON D.C.
			BUORD DWG NO 1311831
		SCALE WT [illegible]	CONT ON SHEET SH NO

CODE IDENT 10001

572D547

SYM	DESCRIPTION	DATE	APPROVAL
A	SEE REV DIR	9MAY60	R.F.S.



UNLESS OTHERWISE SPECIFIED:

NOTES:

1. ALL WIRE TO BE MIL-W-16878 TYPE B (NYLON JACKETED), BLACK, #20 AWG.
2. ALL SHIELDED WIRE (⩶) TO BE MIL-W-16878 TYPE C (NYLON JACKETED), BLACK, #22 AWG.
3. SOLDER ALL CONNECTIONS USING, 12-Z-37400-10
4. LACE ALL CABLES USING LACING CORD, JAN-T-713 TY.S COMP. P. CL. 3 (172B359P.4)
5. AT "PS", "RP", "MS", "RRA", "RA" & "CU" APPLY TERMS., 12-Z-7000-414, TO ALL TERM. POINTS INCLUDING SPARES. TERMINALS TO BE CRIMPED AND SOLDERED.
6. APPLY SLEEVING TO ALL TERMINALS (MIL-I-631 TY. F, SUB. Ua. GR. A, CL. I. CATEGORY 1) AWG. SIZE 8, 3/4 LG., WHITE SLEEVING TO BE MARKED, IN DURABLE BLACK INK, WITH TERMINAL POINT TO WHICH IT CONNECTS USING 3/32 CHARACTERS. i.e.

MS					
1	2	3	4	5	6

MS-1

7. LEGEND FOR SYMBOLS (✱)

"PS"	POWER SUPPLY
"RP"	RESISTOR PACK
"MS"	MAGNET CURRENT SUPPLY
"CU"	CONTROL UNIT
"RS"	RANGE SERVO
"RRA"	RANGE RATE SERVO AMPLIFIER
"RA"	RANGE SERVO AMPLIFIER

8. ON J1 & J2 CONNECTORS USE SLEEVING, MIL-I-631 TY. F, SUB. Ua, GR. A, CL. 1, CATEGORY 1, AWG SIZE 10, 5/8 LG., WHT.
9. USE BUS WIRE, MIL-W-3861, TYPE S, SOFT, COATED (ASTMB33) .032 DIA & SLEEVING, MIL-I-631 TY-F SUB UA GR. A CL 1, CATEGORY 1, AWG SIZE 20 BLK. ON FOLLOWING CONNECTIONS:
   S1
   12-18, 13-19, 14-110, 15-111, 16-112, 21-27, 22-28, 23-29, 24-210, 25-211, 26-212 ON S2, 11-21.
10. USE ONLY BUS WIRE MIL-W-3861, TYPE S SOFT COATED (ASTMB33) .032 DIA. ON FOLLOWING CONN. 31, 32, 33, 34, 34, 35, 36, 37, 38, 39, 310, 311, 312, AT S1
11. ON CABLES FROM J1 & J2 CONNECTORS USE INSULATION SLEEVING 12-Z-7018-1349 & 12-Z-7018-1350
    SEE NOTES 1 THRU 13
12. FOR SINGLE PHASE OPERATION:
    CHANGE LEAD "J1-B TO CU-25" TO "J1-B TO CU-4"
    CHANGE LEAD "F41 TO CU-25" TO "F4-1 TO PS-4
13. WIRING PER MIL-E-16400

1473151

B.F.C.S. MK. 70 MOD. MOD 3 (572D644)

AMPLIFIER MK. 121 MOD 2

WIRING DIAGRAM

GENERAL ELECTRIC

DWG NO. 572D547

NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON, D.C.

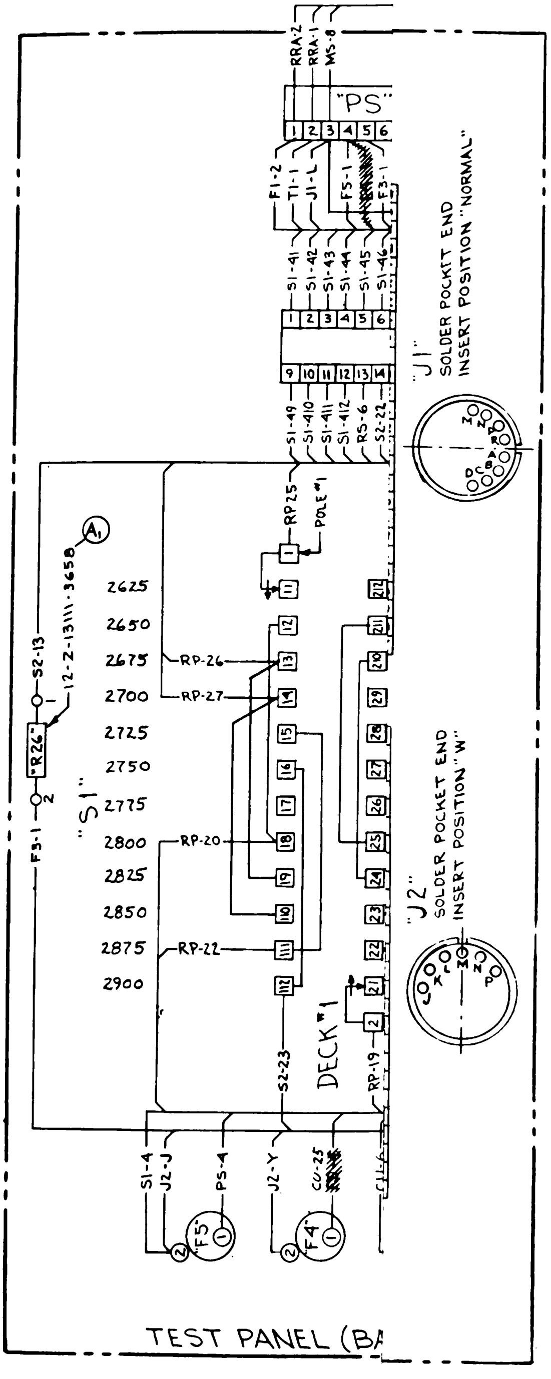
1473151

SCALE
WT
CONT ON SHEET
CODE IDENT 10001

G.E. DWG NO. 572D549 CONT ON SHEET SH NO

THIS COPY FOR USE OF ONLY THE GENERAL ELECTRIC COMPANY AND SUBCONTRACTORS

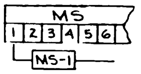
ZONE	SYM	REVISIONS DESCRIPTION	DATE	APPROVAL
D-11	A	SEE REV DIR	6-19-63	J.E.B.
D-11 E-6 E-6 E-6	B	SEE REV DIR	3MAY60	B.P.S.



UNLESS OTHERWISE SPECIFIED:

NOTES:

1. ALL WIRE TO BE MIL-W-16878 TYPE B (NYLON JACKETED), BLACK, #20 AWG.
2. ALL SHIELDED WIRE (⚌) TO BE MIL-W-16878 TYPE C (NYLON JACKETED), BLACK, #22 AWG.
3. SOLDER ALL CONNECTIONS USING, 12-Z-37400-10
4. LACE ALL CABLES USING LACING CORD, JAN-T-713 TY. S COMP. P. CL. 3 (172B359P.4)
5. AT "PS", "RP", "MS", "RRA", "RA" & "CU" APPLY TERMS., 12-Z-7000-414, TO ALL TERM. POINTS INCLUDING SPARES. TERMINALS TO BE CRIMPED AND SOLDERED.
6. APPLY SLEEVING TO ALL TERMINALS (MIL-I-631 TY. F, SUB. Ua. GR. A, CL. I. CATEGORY 1) AWG. SIZE 8, 3/4 LG., WHITE SLEEVING TO BE MARKED, IN DURABLE BLACK INK, WITH TERMINAL POINT TO WHICH IT CONNECTS USING 3/32 CHARACTERS. i.e.



7. LEGEND FOR SYMBOLS (✱)

"PS"	POWER SUPPLY
"RP"	RESISTOR PACK
"MS"	MAGNET CURRENT SUPPLY
"CU"	CONTROL UNIT
"RS"	RANGE SERVO
"RRA"	RANGE RATE SERVO AMPLIFIER
"RA"	RANGE SERVO AMPLIFIER

8. ON J1 & J2 CONNECTORS USE SLEEVING, MIL-I-631 TY. F, SUB. Ua, GR. A, CL. I, CATEGORY 1, AWG SIZE 10, 5/8 LG., WHT.
9. USE BUS WIRE, MIL-W-3861, TYPE S, SOFT, COATED (ASTMB33) .032 DIA ON FOLLOWING CONN: 31, 32, 33, 34, 35, 36, 37, 39, 310, 311, 312 AT S1
10. USE BUS WIRE MIL-W-3861, TYPE S, SOFT COATED (ASTMB33) .032 DIA & SLEEVING, MIL-I-631, TY-F SUB. UA GR A, CLI, CATEGORY 1, AWG SIZE 20 BLK ON FOLLOWING CONN - S1 12-18, 13-19, 14-110, 15-111, 16-112, 21-27, 22-28, 23-29, 24-210, 25-211, 26-212 ON S2, 11-21
11. ON CABLES FROM J1 & J2 CONNECTORS USE INSULATION SLEEVING 12-Z-7018-1349 & 12-Z-7018-1350

SEE NOTES 1 THRU 13

12. FOR SINGLE PHASE OPERATION:
    CHANGE LEAD "J1-B TO CU-25" TO "J1-B TO CU-4"
    CHANGE LEAD "F4-1 TO CU-25" TO "F4-1 TO PS-4"
13. WIRING PER MIL-E-16400

BUORD DWG NO 1473153

F.C.S. MK. 70 MOD 4 (572D543)

AMPLIFIER MK.121 MOD3

WIRING DIAGRAM

DRAWN S. Hughes
DATE Dec 2, 1957
APPD
ISSUED
BUORD APPROVAL
BY DIR CHIEF OF BUREAU
SCALE
WT

GENERAL ELECTRIC
PITTSFIELD
DWG NO 572D549
NAVY DEP'T BUREAU OF ORDNANCE WASHINGTON, D.C.
BUORD DWG NO 1473153
CONT ON SHEET SH NO
CODE IDENT 10001

2094694

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL

NOTES -

1- VALUE OF R11 IS DETERMINED BY TEST TO GIVE CORRECTIONS TO NOMINAL MAGNET CURRENT AS FOLLOWS

CORRECTION %	R11, OHMS
+2	0
+1	10
0	27
-1	62
-2	160
-3	∞

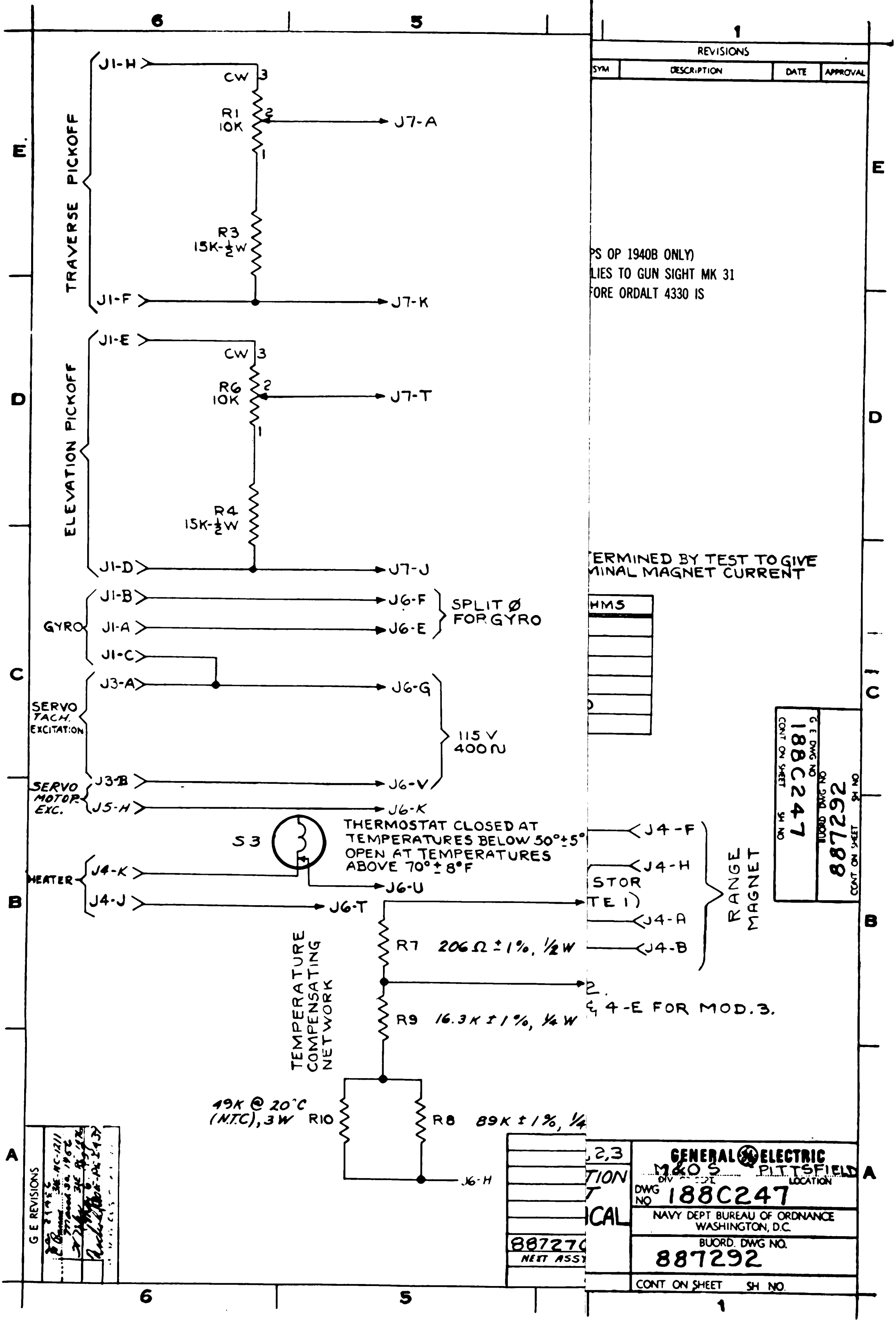
NOTE: (FOR NAVWEPS OP 1940B ONLY) THIS DRAWING APPLIES TO GUN SIGHT MK 31 MODS 1 AND 2 AFTER ORDALT 4330 IS ACCOMPLISHED.

APPROVAL	DATE
ENGINEER	7-15-60
CHECKED	7-15-60
DRAWN Atkinson	5-27-60

GUN SIGHT MK 31 MOD.4,5
ELECTRICAL CONNECTION & CALIBRATION UNIT
SCHEMATIC-ELECTRICAL

DEPARTMENT OF THE NAVY
BUREAU OF WEAPONS
U. S. NAVAL WEAPONS PLANT
WASHINGTON D C

SCALE	UNIT WT	CODE IDENT	BUREAU DRAWING NO
NONE		10001	2094694



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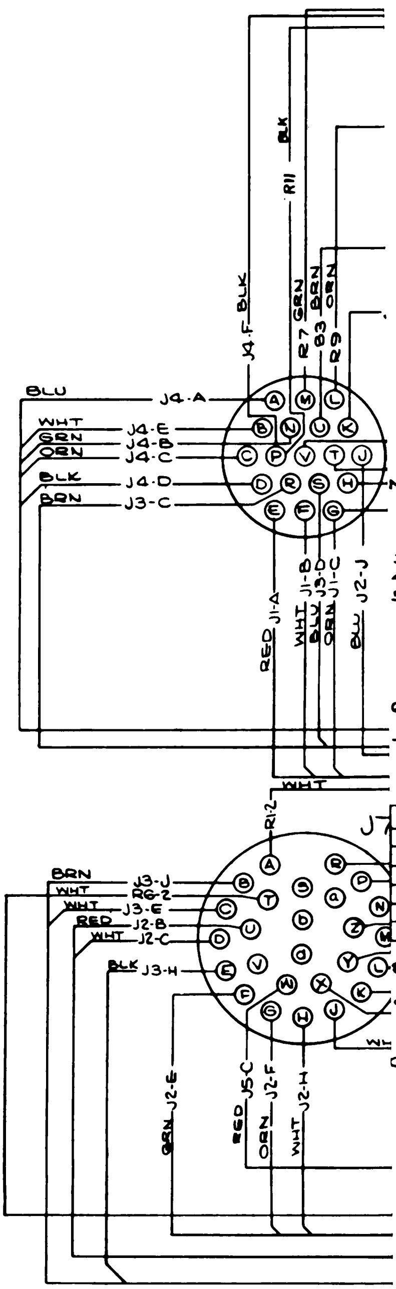
REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL



LEGEND OF WIRE COLORS
COLORS CHOSEN ARBITRARILY
TO FACILITATE CIRCUIT TRACING

SYMBOL	COLOR	ORD. REF.
ORN	ORANGE	SEE NOTE 2
BRN	BROWN	
GRN	GREEN	
BLK	BLACK	
RED	RED	
BLU	BLUE	
WHT	WHITE	

NOTE:

1. ALL WIRE TO BE 20AWG UNLESS OTHERWISE NOTED
2. WIRE TO BE #20AWG 600V-MIL-W-16878 (NAVY) TYPE B WITH NYLON JACKET
3. LACE ALL CABLES USING ORD. 479894-10
4. SOLDER ALL CONNECTIONS USING 12-Z-37400-10
5. AFTER WIRING, MARK RECEPTACLES AND CORRESPONDING PLUGS (RANGE RATE SERVO AND GUNSIGHT) AS FOLLOWS: J1-WHITE, J2-RED, J3-GREEN, J4-YELLOW, J5-BLACK, USING STENCIL INK TT-1-558 AND COVER WITH CLEAR LACQUER, MIL-L-1118.
6. ALL CONNECTORS SHOWN AS VIEWED FROM SOLDER POCKET END.
7. VALUE OF R11 TO BE DETERMINED BY TEST TO GIVE REQUIRED CORRECTION TO NOMINAL MAGNET CURRENT PER THE FOLLOWING TABLE:

CORRECTION %	R11, OHMS	ORD. REF.
+2	0	SEE NOTE 8
+1	10	MILRC20GF100J
0	27	MILRC20GF270J
-1	62	MILRC20GF620J
-2	160	MILRC20GF161J
-3	∞	(NO CONNECTION)

8. CONNECT STANDOFF TERMINALS WITH WIRE #20AWG (BLACK) PER NOTE 2.
9. TUBING TO CONFORM TO MIL-I-631, TYPE F, SUB Ua, GRADE A, CL. I, CAT. 1. SIZES TO BE PER TABLE (SEE BELOW)
0. MIL-W-3861, TYPE S. SOFT, COATED, BARE COPPER WIRE (ASTM B33)

TUBING SIZE	USED ON COMPONENT
AWG #12 (.085 I.D.)	J1, J2, J3, J4, J5
AWG #8 (.133 I.D.)	J6, J7, R1, R6

NOTE: (FOR NAVWEPS OP 1940B ONLY)
THIS DRAWING APPLIES TO GUN SIGHT M
MODS 1 AND 2 AFTER ORDALT 4330 IS
ACCOMPLISHED.

NWP APPROVAL		DATE
ENGINEER		7-15-60
CHECKED		7-15-60
DRAWN	Q.B.M	1 JUN 60
APPROVED		18 July 60

BY DIRECTION OF CHIEF OF BUREAU

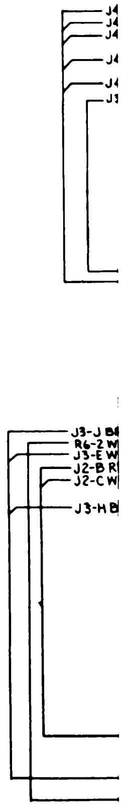
GUN SIGHT, MK31, MOD4,5
ELECTRICAL CONNECTION
& CALIBRATION UNIT
WIRING DIAGRAM

DEPARTMENT OF THE NAVY
BUREAU OF WEAPONS
U. S. NAVAL WEAPONS PLANT
WASHINGTON, D. C.

SCALE NONE
UNIT WT
CODE IDENT 10001
PLANT DRAWING NO 2094695

168D176

SYM	DESCRIPTION	DATE	[illegible]
A1	(1) SEE REV NOT 689792-A	4/16/63	



LEGEND OF WIRE COLORS

COLORS CHOSEN ARBITRARILY TO FACILITATE CIRCUIT TRACING

SYMBOL	COLOR	GE PART NO.	ORD. REF
ORN	ORANGE	8	SEE NOTE 2
BRN	BROWN	10	
GRN	GREEN	6	
BLK	BLACK	3	
RED	RED	5	
BLU	BLUE	7	
WHT	WHITE	4	
▨	SHIELDED	[illegible]	[illegible]

E:

1- ALL WIRE TO BE 20 AWG UNLESS OTHERWISE NOTED.

2- WIRE TO BE #20 AWG 600V-MIL-W-16878 (NAVY) TYPE B WITH NYLON JACKET.

3-

4- LACE ALL CABLES USING ORD. 479894-10.

5- SOLDER ALL CONNECTIONS USING 12-Z-37400-10.

6- AFTER WIRING, MARK RECEPTACLES AND CORRESPONDING PLUGS (RANGE RATE SERVO AND GUNSIGHT) AS FOLLOWS: J1 WHITE, J2 RED, J3 GREEN, J4 YELLOW, J5 BLACK USING STENCIL INK TT-I-558 AND COVER WITH CLEAR LACQUER MIL-L-1118.

7- ALL CONNECTORS SHOWN AS VIEWED FROM SOLDER POCKET END.

8- VALUE OF R11 TO BE DETERMINED BY TEST TO GIVE REQUIRED CORRECTION TO NOMINAL MAGNET CURRENT PER THE FOLLOWING TABLE:

CORRECTION, %	R11, OHMS	ORD. REF.	G.E. PART NO.
12	0	SEE NOTES	SEE NOTES
+1	10	MIL-RC20GF100J	14
0	27	MIL-RC20GF270J	15
−1	62	MIL-RC20GF620J	16
−2	160	MIL-RC20GF161J	17
−3	∞	(NO CORRECTION)	(NO CORRECTION)

9- CONNECT STANDOFF TERMINALS WITH WIRE #20 AWG (BLACK) PER NOTE 2.

10- TUBING TO CONFORM TO MIL-I-631 TYPE F, SUB Ua, GRADE A, CL. I, CAT. I SIZES TO BE PER TABLE (SEE BELOW).

11- MIL-W3861 TYPE S, SOFT, COATED, BARE COPPER WIRE (ASTM B 33)

G.E. PT. NO.	TUBING SIZE	USED ON COMPONENT
19	AWG #12 (.085 I.D.)	J1, J2, J3, J4, J5
20	AWG #8 (.133 I.D.)	J6, J7, R1, R6

SEE NOTES 1 TO 11 INCL.

G.E. WIRING METHODS PER S.I. 13404

689792

NOTE: (FOR NAVWEPS OP 1940B ONLY)
THIS DRAWING APPLIES TO GUN SIGHT MK 31
MODS 1 AND 2 BEFORE ORDALT 4330 IS
ACCOMPLISHED.

(188C191)
NTROL SYSTEM MK. 70 MOD. 2

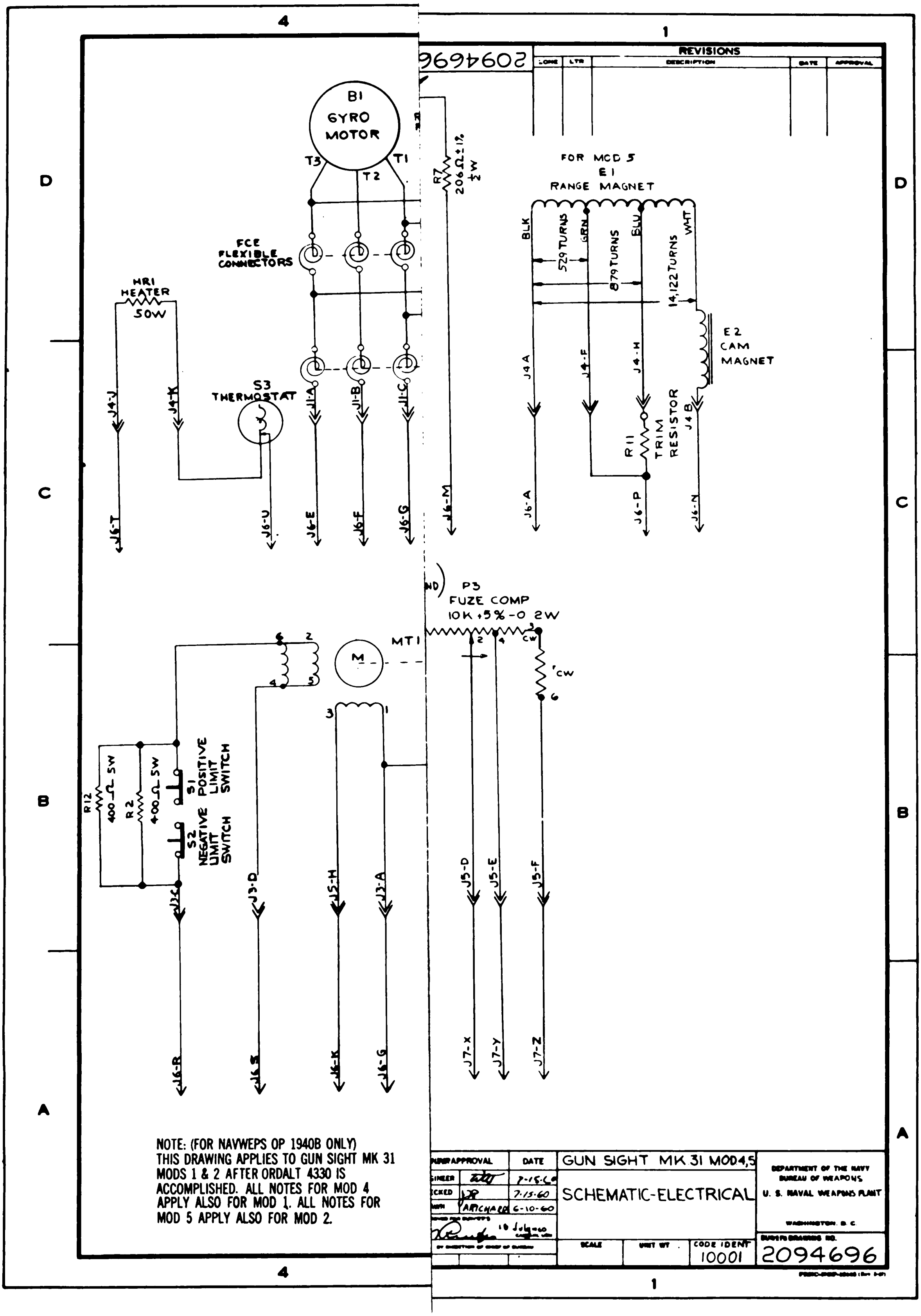
SPECIFIED
INCHES
ANGLES ±
DRAWING

DRAWN
DATE 1955
ISSUED
BUORD APPROVAL

GUN SIGHT MK. 31 MOD. 1, 2, 3
ELECTRICAL CONNECTION
& CALIBRATION UNIT
WIRING DIAGRAM

SCALE
WT

GENERAL ELECTRIC
M.O.S.
PITTSFIELD
LOCATION
DWG NO. 168D176
NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON D.C.
BUORD DWG NO.
689792
CONT ON SHEET
SH NO



NOTE: (FOR NAVWEPS OP 1940B ONLY)
THIS DRAWING APPLIES TO GUN SIGHT MK 31 MODS 1 & 2 AFTER ORDALT 4330 IS ACCOMPLISHED. ALL NOTES FOR MOD 4 APPLY ALSO FOR MOD 1. ALL NOTES FOR MOD 5 APPLY ALSO FOR MOD 2.

2 1

THIS COPY FOR USE OF ONLY THE GENERAL ELECTRIC COMPANY AND SUBCONTRACTORS

ZONE	REVISIONS			
	SYM	DESCRIPTION	DATE	APPROVAL
C-6	A1	SEE REV DIR	26MAR59	C.F.W.

E

NOTE: (FOR NAVWEPS OP 1940B ONLY)
THIS DRAWING APPLIES TO GUN SIGHT MK 31
MODS 1 AND 2 BEFORE ORDALT 4330 IS
ACCOMPLISHED.

D

C

CONT ON SHEET 188C222 SH NO
ON DWG NO 1,2
BUORD DWG NO 887288
CONT ON SHEET SH NO

E:
ROWS INDICATE ROTATION FOR
REASING RANGE RATE

INDICATES ALL PARTS OF
CUIT SHIELDED.

IS POT IS 200 Ω FOR MODS. 1 & 3
D 400 OHMS FOR MOD. 2

IS POT IS USED ON MODS. 1 & 2 AND
NOT USED ON MODS

B

(168D164)
SYSTEM MK.70 MOD.2

A

GUN SIGHT MK.31 MOD.1,2,3
RANGE RATE SERVO
SCHEMATIC-ELECTRICAL

GENERAL ELECTRIC
M.&O.S PITTSFIELD
LOCATION
DWG NO. 188C222
NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON, D.C.
BUORD. DWG NO.
887288

SCALE WT-SAME

CONT ON SHEET SH NO.

D APPROVAL

2 1

1

2094693

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVAL
C2	A.	(1) SEE REV NOT 2094693-A	1/24/61	

NOTES:
1. TUBING TO CONFORM TO MIL-I-631 TYPE F, SUBFORM Ua, GRADE A, CL I. CAT I SIZES TO BE PER TABLE

TUBING SIZE (SEE NOTE 1.)	USED ON COMPONENT
AWG # 9 (.118 ID)	S1, S2, P1, P4
AWG # 15 (.059 ID)	J2 J3 J5
AWG # 8 (.133 ID)	MT1

2. ALL WIRE TO BE 20 AWG EXCEPT AS NOTED.
3. WIRE TO BE 600 VOLTS PER MIL-W-16878 (NAVY) TYPE B, WITH NYLON JACKET (#20 AWG)
4. LACE ALL CABLES USING ORD 479894-10.
5. SOLDER ALL CONNECTIONS USING 12-Z-37400-10.
6. AFTER WIRING, MARK PLUGS WITH PAINT TO CORRESPOND WITH PAINT MARKS OF MATING RECEPTACLES OF ELECTRICAL CONNECTION AND CALIBRATION UNIT, AS SPECIFIED ON WIRING DIAGRAM, 689792.
7. ADD TO CABLE RUN OF EACH PLUG J2, J3, & J5, 8 INCHES OF TUBING 351260 P 1235
8. THIS POT (200 Ω) FOR MOD 4 FOR MOD 5 IT IS OF 400 Ω VALUE.

LEGEND OF WIRE COLORS
WIRE COLORS CHOSEN ARBITRARILY TO FACILITATE CIRCUIT TRACING

SYMBOL	COLOR	ORD REFERENCE
ORN	ORANGE	SEE NOTE 3
BRN	BROWN	
GRN	GREEN	
BLK	BLACK	
RED	RED	
BLU	BLUE	
WHT	WHITE	
	SHIELDED	1202873-1

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± DECIMALS ± . ANGLES ±	NAP APPROVAL	DATE	GUN SIGHT MK. 31 MOD 4, 5	DEPARTMENT OF THE NAVY BUREAU OF WEAPONS U. S. NAVAL WEAPONS PLANT WASHINGTON, D. C.
	ENGINEER ZGT	7-15-60	RANGE RATE SERVO WIRING DIAGRAM	
	CHECKED	7-15-60		
DO NOT SCALE THIS DRAWING	DRAWN ARomeros	5-31-60		
MATERIAL.	APPROVED FOR BUWEPS 18 July 60 BY DIRECTION OF CHIEF OF BUREAU		SCALE	UNIT WT
			CODE IDENT. 10001	BUWEPS DRAWING NO. 2094693

1

1

2094697

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVAL

SYMBOL	COLOR	ORD. REF
=====		1202873-1
WHT	WHITE	SEE NOTE 1
BLK	BLACK	
BRN	BROWN	
RED	RED	
ORN	ORANGE	
GRN	GREEN	
BLU	BLUE	

SIZE NO.	NOMINAL I.D.	USED ON COMPONENT
2	.263	HRI
13	.076	J1, J4
3	.234	I1, I2
5	.186	R5
SLEEVING		

NOTES

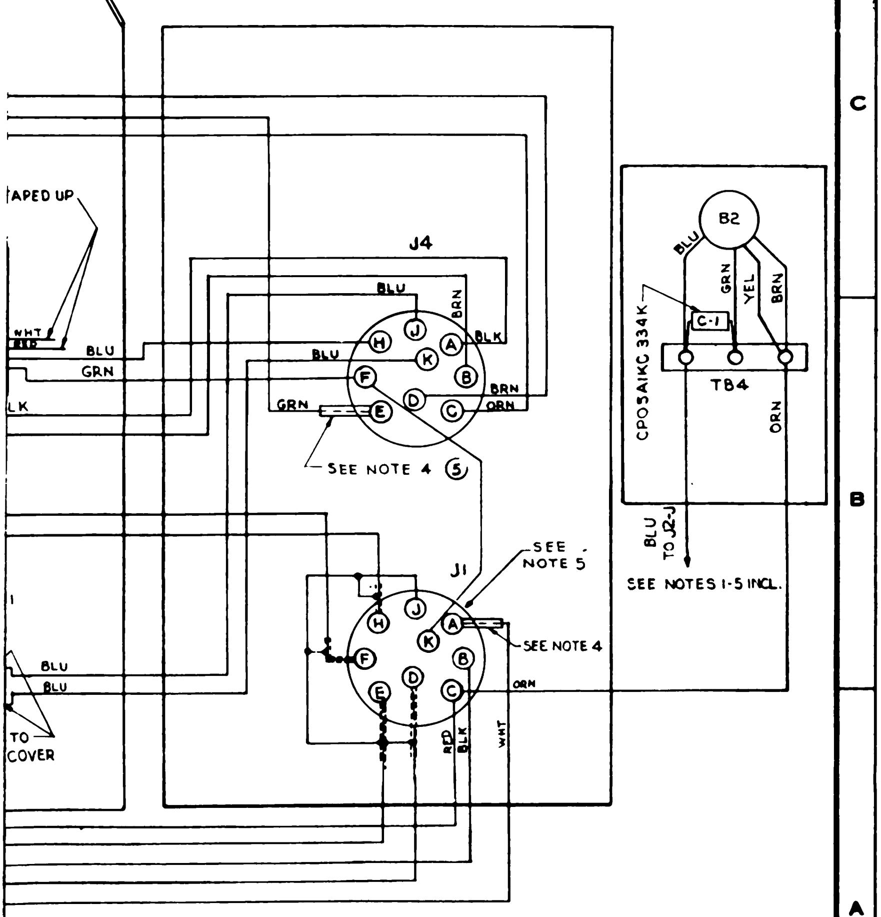
1-ALL WIRE TO BE #20 AWG 600V PER MIL-W-16878 (NAVY) TYPE B WITH NYLON JACKET, EXCEPT WHERE NOTED.

2-SOLDER ALL CONNECTIONS USING SOLDER 12-Z-37400-10

3-AFTER WIRING, MARK PLUGS J1 AND J4 WITH PAINT TO CORRESPOND WITH PAINT MARKS OF MATING RECEPTICALS OF ELECTRICAL CONNECTION AND CALIBRATION UNIT AS SPECIFIED ON WIRING DIAGRAM.

4.ALL SLEEVING TO BE MIL-I-631 TY. F, SUB Ua, GR.A, CL.I, CAT. I, WHITE. SEE TABLE.

5-WIND A MIN. OF 6 TURNS OF LACING CORD 479894-10 AROUND THE TUBING AT PLUG J1.



UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS ± DECIMALS ± . ANGLES ±

DO NOT SCALE THIS DRAWING

MATERIAL:

NWP APPROVAL		DATE
ENGINEER	ZLT	7-15-60
CHECKED	JJP	7-15-60
DRAWN	Atkinson	6-1-60

APPROVED FOR BUREAU
18 July 60
BY DIRECTION OF CHIEF OF BUREAU

GUN SIGHT MK.31 MOD 4, 5

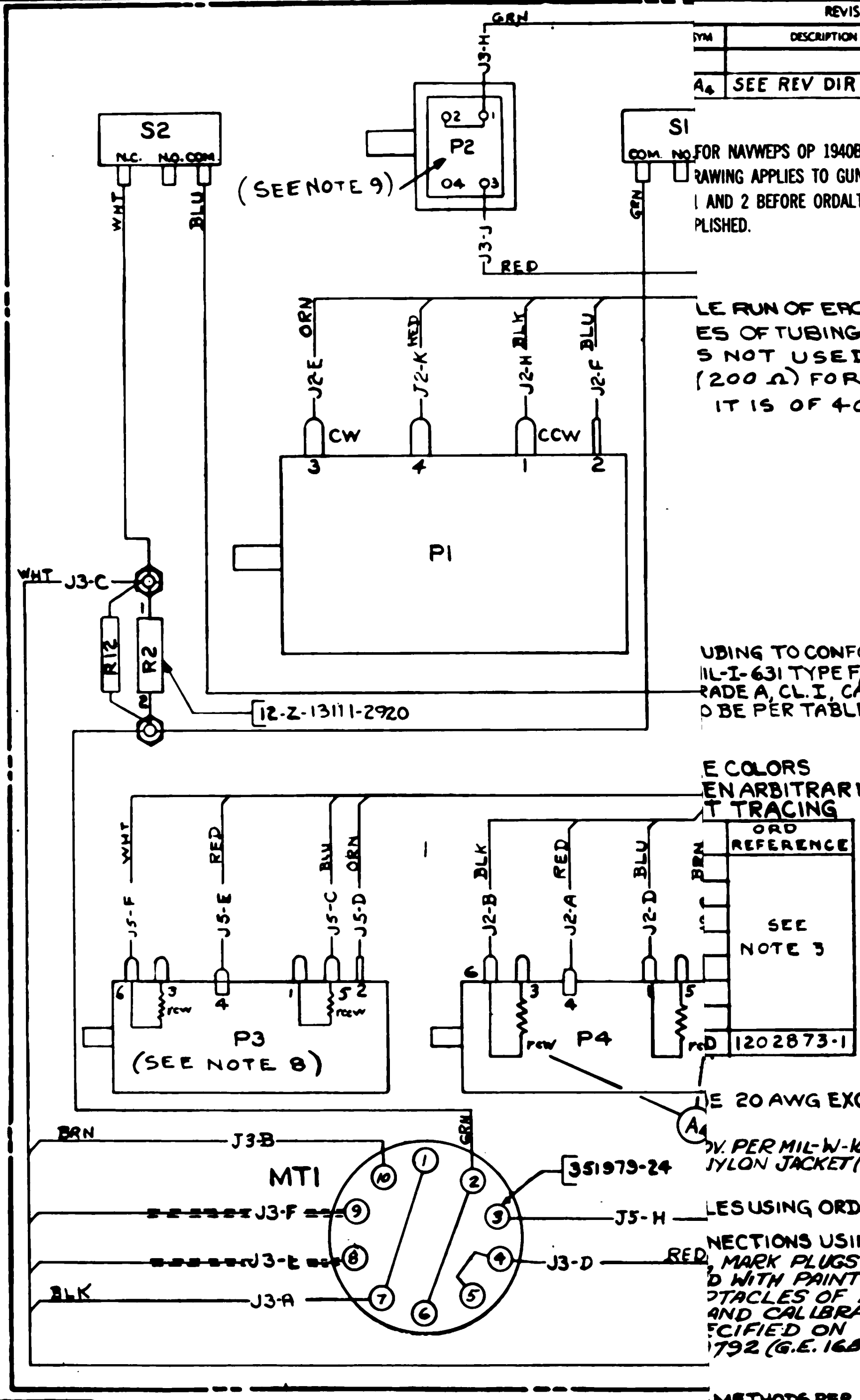
WIRING DIAGRAM

DEPARTMENT OF THE NAVY
BUREAU OF ORDNANCE
U. S. NAVAL WEAPONS PLANT
WASHINGTON, D. C.

SCALE	UNIT WT	CODE IDENT	BUORD DRAWING NO.
NONE		10001	2094697

1

SYM	DESCRIPTION	DATE	APPROVAL
REVISIONS			
A_4	SEE REV DIR	24MAR59	C.F.W.



FOR NAVWEPS OP 1940B ONLY)
RAWING APPLIES TO GUN SIGHT MK 31
1 AND 2 BEFORE ORDALT 4330 IS
PLISHED.

LE RUN OF EACH PLUG J2, J3
ES OF TUBING 351260P1235
S NOT USED ON MOD.3.
(200 Ω) FOR MODS. 1 & 3.
IT IS OF 400 Ω VALUE.

UBING TO CONFORM TO
IIL-I-631 TYPE F, SUBFORM Ua,
RADE A, CL. I, CAT1. SIZES
O BE PER TABLE

E COLORS
EN ARBITRARILY TO
T TRACING

E 20 AWG EXCEPT

V. PER MIL-W-16878 (NAVY)
NYLON JACKET (#20 AWG)

LES USING ORD.479894-10

NECTIONS USING 12-Z-37400-10.
, MARK PLUGS WITH PAINT
D WITH PAINT MARKS OF
PTACLES OF ELECTRICAL
AND CALIBRATION
ECIFIED ON WIRING
792 (G.E. 168D176).

METHODS PER S.I. 13404)

CONT ON SHEET	G E DWG NO 188C223	SH NO
CONT ON SHEET	BUORD DWG NO 887289	SH NO

G L REVISIONS
1 [illegible]
2 [illegible]
3 [illegible]
4 [illegible]
5 [illegible]
6 ADD. CUST. APPROVAL

SEE NOTES 1 TO
9 INCL.

1311B22
NEXT ASSY

,2,3

GENERAL ELECTRIC
M.E.O.S. PITTSFIELD
LOCATION
DWG NO 188C223
NAVY DEPT BUREAU OF ORDNANCE
WASHINGTON, D.C.
BUORD. DWG NO.
887289
CONT ON SHEET SH NO.

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